San Juan River Basin
Recovery Implementation Program

Final
Annual Budget and Work Plan
Fiscal Year 2001

October 12, 2000

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U.S. Fish and Wildlife Service

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Page #	Title	Agency	Program	BIA Direct	Other Direct	Total	Base or Capital
I. Monitoring							
2	Adult Fish Community Monitoring	FWS, GJ	$ 54,400			$ 54,400	B
5	YOY/Small Bodied Fish Monitoring	NMDGF	$ 51,700			$ 51,700	B
9	Larval Drift - Colorado Pikeminnow	UNM, NMDGF	$ 35,834			$ 35,834	B
13	Larval Razorback Sucker Survey	UNM, NMDGF	$ 21,965			$ 21,965	B
17	Specimen Curation/Identification	UNM	$ 35,938			$ 35,938	B
20	Channel Morphology	KB		$ 115,031		$ 115,031	
24	Habitat Mapping	KB/ERI		$ 50,472		$ 50,472	
26	Water Temperature Monitoring	KB/ERI		$ 6,265		$ 6,265	
28	Water Quality Monitoring	KB		$ 22,920		$ 22,920	
31	GIS Database Maintenance	KB		$ 26,272		$ 26,272	
	subtotal		**$ 199,837**	**$ 220,960**		**subtotal $ 420,797**	

Page #	Title	Agency	Program	BIA Direct	Other Direct	Total	Base or Capital
II. Program Reporting							
34	Peer Review	BIO/WEST	$ 0			$ 0	B
	subtotal		**$ 0**			**subtotal $ 0**	
III. Research Activities							
38	Suppression of Red Shiner	NMDGF, UNM	$ 40,700			$ 40,700	B
45	Population Estimates and Model Refinement	MEC, ERI	$ 20,262	$ 72,402		$ 92,664	B
51	PAH Study	BLM			$ 50,000	$ 50,000	
	subtotal		**$ 60,962**	**$ 72,402**	**$ 50,000**	**subtotal $ 183,364**	

Page #	Title	Agency	Program	BIA Direct	Other Direct	Total	Base or Capital
IV. Recovery Efforts							
56	Nonnative Species Control	FWS, Abq	$ 117,240			$ 117,240	B
63	Razorback Sucker Augmentation	FWS, G.J.	$ 62,600			$ 62,600	C
69	Augmentation Plan - Colorado Pikeminnow	FWS, G.J.	$ 17,400			$ 17,400	C
71	Genetics Management Plan	BOR	$ 7,920			$ 7,920	B
74	Experimental Culturing and Stocking of Roundtail Chub	NMDGF, CDOW,UNM			$ 20,000	$ 20,000	
no pg #	Pit tags	BOR	$ 40,000			$ 40,000	C
	subtotal		**$ 245,160**		**$ 20,000**	**subtotal $ 265,160**	
V. Hydrology Committee Proposals							
81	San Juan RIP Naturalized Flows	BOR	$ 400,000			$ 400,000	B
92	Improve Stream Gaging and Flow Measurements	BOR	$ 21,708			$ 21,708	B
94	Additional Model Runs	BOR	$ 10,000			$ 10,000	B
	subtotal		**$ 431,708**			**subtotal $ 431,708**	

Page #	Title	Agency	Program	BIA Direct	Other Direct	Total	Base or Capital
VI. Program Coordination and Program Management							
96	Program Coordination	FWS, Abq.	$ 109,000			$ 109,000	B
98	Program Management	BOR	$ 65,000			$ 65,000	B
	subtotal		**$ 174,000**			**subtotal $ 174,000**	
VII. Capital Projects							
99	Capital Projects Management	BOR	$ 80,000			$ 80,000	C
99	PNM Diversion Dam	BOR	$ 1,558,500			$ 1,558,500	C
99	Hogback and Cudei Diversion Dams	BOR	$ 871,500			$ 871,500	C
	subtotal		**$ 2,510,000**			**$ 2,510,500**	
	Grand Total		**$ 3,621,667**	**$ 293,362**	**$ 70,000**	**$ 3,985,029**	

Summary

I.	Monitoring Proposals	$ 420,797
II.	Program Reporting Proposals	$ 0
III.	Research Proposals	$ 183,364
IV.	Recovery Proposals	$ 265,160
V.	Hydrology Committee Proposals	$ 431,708
VI.	Program Coordination and Program Management Proposals	$ 174,000
VII.	Capital Projects	$ 2,510,000
	Total Program Budget Proposals	**$ 3,985,029**

I. Monitoring Proposals

Adult/Juvenile Fish Community Monitoring
Fiscal Year 2001 Project Proposal

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Background:

Studies performed before 1991 documented a native San Juan River fish fauna of eight species, including Colorado pikeminnow (previously known as Colorado squawfish), razorback sucker, and roundtail chub and provided baseline information on distribution and abundance of native and introduced fish species in the San Juan River. Main channel fish community monitoring studies (known as "adult monitoring") performed from 1991 to 1998 refined this baseline data and provided data on specific habitat usage by rare fish species. Adult monitoring has proven to be the most effective tool for monitoring populations of stocked razorback sucker and recently stocked adult Colorado pikeminnow. In addition adult monitoring has recently captured numerous stocked, early life stage Colorado pikeminnow. Information gathered during adult monitoring also aided in the selection of specific sites for detailed hydrologic measurements and larval drift sampling. Integration of adult monitoring data with data from Colorado pikeminnow macrohabitat studies, razorback sucker experimental stocking studies, tributary and secondary channel studies, fish health studies, contaminants studies, habitat mapping studies, and non-native species interaction studies, helped provide data to make flow recommendations for reoperation of Navajo Reservoir.

Thirty-two intensive electrofishing surveys conducted from 1991 to 1999 expanded our knowledge on the distribution and abundance of the San Juan River fish community. As of October 1999, nineteen wild juvenile and adult Colorado pikeminnow have been collected and PIT-tagged; 13 of the 19 Colorado pikeminnow were radio-tagged. In addition, 10 adult and 188 juvenile, experimentally-stocked Colorado pikeminnow have been recaptured. Ninety-five of these fish were captured on the October 1998 adult monitoring trip. Twenty-four roundtail chub were collected, 19 of these were PIT-tagged. No wild razorback sucker were collected, however 73 stocked razorback sucker have been recaptured during adult monitoring trips.

The need for a long-term, standardized monitoring program, such as the adult monitoring study is addressed in objective 5.7.1, a Milestone in the San Juan River Long Range Plan. Additionally, future monitoring will help determine fish community response to reoperation flows from Navajo Dam (objective 5.2.10), as well as monitoring both wild and augmented populations of Colorado squawfish and razorback sucker (objective 5.3.9).

Adult monitoring will continue with one trip in fall 2001, to measure fish community response to reoperation flows from Navajo Dam, monitor populations of experimentally-stocked Colorado pikeminnow and razorback sucker, and assess impacts of instream diversion structures to native fish species. In support of objective #4

below, nonnative fish removal will continue to be done on all adult monitoring trips. The study design for adult monitoring is based upon the criteria for long-term monitoring of the San Juan River main channel fish community. These criteria were accepted as final by the San Juan River Biology Committee on 31 March 2000.

Description of Study Area:

The study area for adult monitoring extends from river mile (RM) 180.0 (Animas River confluence) in Farmington, New Mexico, downstream to RM 2.9 (Clay Hills Landing) just above Lake Powell in Utah. The entire reach of river from RM 180.0 to RM 2.9 will be sampled in the fall of every year (sampling to begin in the second to third week of September).

Objectives:

1. Determine shifts in fish community structure, abundance and distribution, and length/weight frequencies under the reoperation flow regime.

2. Monitor Colorado pikeminnow population trends (spawning and staging areas, habitat needs).

3. Monitor experimentally stocked razorback sucker and Colorado pikeminnow (growth rates, dispersal patterns and habitat use).

4. Remove nonnative fish species which prey upon and compete with native fish species in the San Juan River.

5. Produce an interim progress report for results and findings of 2000 adult monitoring field work.

Methods:

Objectives 1-5: One adult monitoring trip will take place in fall 2001. The fall trip will sample from the Animas River confluence in New Mexico (RM 180.0) to Clay Hills Landing in Utah (RM 2.9). Electrofishing will be the primary sampling technique, although seining and trammel netting may also be employed.

Two oar-powered rafts, with one netter each, will electrofish in a continuous downstream fashion, with one raft on each far shoreline. No outboard motors will be used. Sampling crews will consist of approximately 8-9 people (4 for electrofishing, 2 for baggage rafts, and 2-3 for other research elements that are being done simultaneously with our sampling). Electrofishing will be conducted in a continuous downstream fashion, sampling two out of every three miles (approximately 120 total sampled miles). All fish collected will be enumerated by species and life stage every sampled mile. Every fifth sampled mile (designated mile), all fish collected will be weighed, measured, and sexed if possible. All native fish collected will be returned alive to the river. All nonnative fish collected will be removed from the river. All predatory lacustrine fishes (i.e. - walleye, striped bass, largemouth bass, small mouth bass, etc.) collected will be weighed, measured, and have stomach contents taken, before being removed from the river. Tag numbers, total length, and weight will be recorded on all recaptured, FLOY-tagged fish (both native and nonnative), as well as any rare fish collected. Colorado pikeminnow and wild razorback sucker greater than 200 mm TL will be implanted with PIT (Passive

Integrated Transponder) tags. Wild, adult Colorado pikeminnow will also be implanted with radio transmitters. Notes will be kept on any parasites and/or abnormalities observed on collected fishes.

Radio tag implantation and fish transport will follow the protocols attached to the San Juan River Seven Year Research Plan (1991). Electrofishing will follow the methods set forth above and in the long term monitoring plan. Seining and trammel netting will be done where suitable habitat is available at the sampling crews' discretion. The Service will have the lead for these adult monitoring trips and other cooperating agencies will provide personnel and equipment as needed. Costs for cooperating agencies are not included in this budget.

Products:

An interim progress report for the adult monitoring trip conducted in 2001 is scheduled to be available by 31 March 2002. The "draft final" of this report, which incorporates comments received, is scheduled to be completed by 1 June 2002. DBASE IV files containing information on total catch and length/weight data gathered on adult monitoring trips will be submitted to Keller-Bliesner Engineering for inclusion on the San Juan River Recovery Implementation Program integrated database CD-ROM by 31 March 2002.

Budget:

Personnel costs	
1 GM-14 Supervisor	$ 6,000
1 GS-11 Fishery Biologist	$15,000
1 GS- 7 Administrative Support	$ 1,500
Data analysis and report costs	$ 5,000
Travel-Per Diem	$ 6,500
Equipment and Supplies	$ 3,000
Subtotal	$37,000
Service Administrative Overhead (20.00%)	$ 7,400
U.S. Fish and Wildlife-CRFP Subtotal	$44,400
Funding for participation of other agencies	
New Mexico Dept. of Game and Fish-Santa Fe	$ 2,000
U.S. Fish and Wildlife Service-Albuquerque	$ 4,000
Utah Division of Wildlife Resources-Moab	$ 4,000
GRAND TOTAL	**$ 54,400**

YOY/Small Bodied Fish Monitoring
Fiscal Year 2001 Project Proposal

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Study Area:

The study area for YOY/small bodied fish monitoring extends from river mile (RM 180.0 (Animas River confluence) in Farmington, New Mexico, downstream to RM 2.9 (Clay Hills Crossing) just above Lake Powell in Utah.

Collections:

Specimens collected will be inspected to determine if any rare fishes (Colorado pikeminnow, roundtail chub, and razorback sucker) are present in the seine. All identifiable rare fish and all large- bodied native fish (i.e., flannelmouth and bluehead suckers) >150 mm TL will be released. All other specimens will be preserved in 10% formalin and returned to the New Mexico Department of Game and Fish Laboratory for identification, enumeration, and measurement (total length and weight).

Background:

As set forth in Section 5.7 of the San Juan River Basin Recovery Implementation Program (SJRIP) Long-Range Plan, a long-term monitoring program "to identify changes in the endangered and other native species populations, status, distributions and habitat conditions" was to be developed by the SJRIP Biology Committee. The ichthyofaunal monitoring portion of the San Juan River Monitoring Plan and Protocols (Propst, et al., 2000) was divided into four primary areas, larval fish—drift sampling, larval fish--seining, young-of-year/small bodied, and subadult and adult/large-bodied fishes. The portion of the San Juan River to be monitored extends from the confluence of the Animas and San Juan rivers (Farmington) to Lake Powell (Clay Hills Crossing). The following work proposal for 2001 is to conduct the young-of-year/small-bodied fishes monitoring effort per protocols set forth in the San Juan River Monitoring Plan and Protocols (SJRMPP).

In addition to accomplishing work (field, laboratory, data analysis, and report writing) specific to the young-of-year/small-bodied fish monitoring effort, this proposal includes work that is devoted to reviews of reports (e.g.,

annual and project completion reports) generated by other participants in the San Juan River Basin Recovery Implementation Program.

Objectives:

The objectives of this portion of the San Juan River monitoring effort are to obtain data that will aid in the evaluation of the response (e.g., reproduction, recruitment, and growth) of native and nonnative fishes to different flow regimes and other management actions (e.g., impediment modification), track trends in species populations (e.g., abundance and relative condition), and characterize patterns of habitat use. The data will also be available to all researchers and may be used in conjunction with data obtained in other studies to evaluate future management activities.

Methods:

The study reach (Farmington to Clay Hills Crossing) includes geomorphic reaches 6 through 1, with Reach 1 being the most downstream. As stated in SJRMPP, sampling will occur every third mile within the study reach. Secondary channels are defined as channels having less than 25% of the volume of flow at the time of sampling and are at least 300 m in length. Inflow of water at the top of a channel is not necessary for it to be classified as a secondary channel. If any portion of a secondary channel (except mouth) is within a designated sample mile, the secondary channel will be sampled. Young-of-year/small-bodied fish monitoring will occur in conjunction with the large-bodied fish monitoring effort. All secondary channels in each third-mile will be sampled. Primary channel shoreline habitats also will be sampled in 3-mile increments.

Primary channel and secondary channel sampling sites will be within the same river mile. In addition to structured primary channel sampling, all backwaters and embayments (>25 m^2) associated with the primary channel within each third-mile will be sampled.

Sample sites within secondary channels will be a sufficient distance from the inflow to and outflow from the secondary channel to minimize primary channel faunal and physiochemical influences. Secondary channel sample sites will be at least 100 and not more than 200 m in length. All mesohabitats (e.g., pool, riffle, riffle-eddy, and shoal) within the site will be sampled in approximate proportion (visually estimated) to their availability within the site; typically, at least five mesohabitat types will be sampled in each secondary channel. Each mesohabitat will be sampled separately with 3.2 x 1.6 m (4 mm mesh) drag seines. Each secondary channel sampling effort will be a minimum of 5 seine hauls. The number of seine hauls, total area (m^2) seined, and types of mesohabitats sampled will be recorded on standard field forms. Specimens collected in each mesohabitat will be inspected to determine if any rare fishes (Colorado pikeminnow, roundtail chub, and razorback sucker) are present in the seine. If a rare fish is captured, it will be identified, total and standard lengths (±1 mm) and mass (±1 g) determined, and released. Any rare fish >150 mm TL will be scanned to determine presence of a PIT tag. If none is present, the specimen will be implanted with a PIT tag having a unique alphanumeric code. All pertinent data (i.e., total and standard lengths, weight, PIT tag code, mesohabitat, water depth, substrate, and cover) on rare fish captured will be recorded. All large-bodied native fish (i.e., flannelmouth and bluehead suckers) will be weighed, measured, and released. All other specimens will be preserved in 10% formalin and returned to the New Mexico Department of Game and Fish Laboratory

for identification, enumeration, and measurement (total length and mass). Field collection number, habitat number, and river mile will be recorded on a water-proof label and placed in each specimen container. Location of site (latitude and longitude) will be determined with a GPS unit. Identification of all retained rare fishes will be confirmed by personnel of the Museum of Southwestern Biology. Preserved specimens will be accessioned to the New Mexico Department of Game and Fish Collection of Fishes or the University of New Mexico Museum of Southwestern Biology.

Within each third-mile (= designated mile), shoreline habitats of the primary channel will be sampled. At each designated mile, all mesohabitats (e.g., riffle, debris pool, and shoal) along 200 m (near center of mile) of shoreline will be sampled. All mesohabitats present will be sampled in approximate proportion (visually estimated) to their availability within the site. Regardless of the number of mesohabitats present at a primary channel site, at least 5 seine hauls will be made with a drag seine (3.2 x 1.6 m, 4 mm mesh). The shoreline (river right or left) sampled will be dependent upon accessibility of the shoreline. Where more than one shoreline is accessible (and can be seined efficiently), that with greater habitat diversity/complexity (visually estimated) will be sampled. Location (latitude and longitude) will be determined with a GPS unit. Specimen and habitat data will be obtained and recorded as required for secondary channel sampling. Rare species and large-bodied specimens of common native species will be handled as described for secondary channels. All retained specimens from primary channel sampling will be preserved separately from the adjacent secondary channel collection. All retained specimens will be accessioned to the New Mexico Department of Game and Fish Collection of Fishes or the University of New Mexico Museum of Southwestern Biology.

Backwaters and embayments (>25 m^2) not located within designated primary channel sampling miles (each third mile) also will be sampled. During periods of low flow, secondary channel mouths frequently function as backwaters or embayments. In this monitoring effort, secondary channel mouths without surface inflow from upstream will be treated as backwater/embayment habitat. The maximum number of backwaters or embayments sampled will be one per mile (excluding designated mile). Three seine hauls will be made in each backwater or embayment sampled. All specimens collected, except rare fishes, will be retained and returned to the laboratory for identification and enumeration. All rare fish will be measured and released; those >150 mm will be PIT tagged. Data collection and recording of relevant information (including GPS determined location) will be the same as for secondary and primary channels.

Water quality data (ambient temperature, water temperature, dissolved oxygen, conductivity, and salinity) will be measured in each sampled secondary channel, at primary channel sites and in backwaters/embayments. Secondary channel water quality data will be obtained a sufficient distance from the inflow to the secondary channel to minimize primary channel influences. All water quality data for each sample will be recorded on standard field forms.

Products:

Data collected during the 2001 monitoring effort will be summarized by geomorphic reaches. Minimally, the annual report will report density per species (number/m^2) per geomorphic reach, size-structure of commonly-collected species populations by geomorphic reach, and rare fishes and the mesohabitats each was found in. Data obtained from secondary and primary channel sampling will be reported separately. Backwater and

embayment data will be reported in the primary channel portion of the annual report. Community-comparison metrics, such as Shannon-Wiener Diversity Index and Morisita's Index of Similarity, will be used for longitudinal and annual comparisons. River discharge data (Four Corners gage) will be used to assess the effect of discharge volume on species density estimates. All data obtained during 2000 monitoring activities will be electronically recorded in a format to be determined by the SJRIP Biology Committee. The annual report (including electronic database) will be submitted to the SJRIP Biology Committee by 31 March 2002.

Literature Cited:

Propst, D.L., S. P. Platania, D.W. Ryden, and R. Bliesner. 2000. San Juan River Monitoring Plan and Protocols. San Juan Basin Recovery Implementation Program. U.S. Fish and Wildlife Service, Albuquerque, NM.

Budget[1]:

Young-of-year/small-bodied monitoring (Field)

Personnel	$ 8,000
Travel and per diem	4,000

Specimen sorting and identification, specimen curation, and data compilation

Personnel	$15,000

Annual small-bodied/YOY data synthesis, analysis, and report preparation

Personnel	$10,000
Administrative Support	2,000
Subtotal	$39,000

Report reviews (e.g., annual & Long Range Plan) and meeting attendance (per diem only)

Personnel	$ 5,000
Travel and Per Diem	2,000
Administrative Support	1,000
Subtotal	$ 8,000

TOTAL	$47,000
Indirect Costs (10 %)	4,700
GRAND TOTAL	**$51,700**

[1]Budget does not include in-kind contributions.

San Juan River Larval Fish Passive Drift-Netting
Fiscal Year 2001 Project Proposal

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Background:

Beginning in spring 1995, personnel from the Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico assumed responsibility for the San Juan River larval fish passive drift-netting study. This project, formerly conducted by the Utah Division of Wildlife Resources, continued with only minor changes in sampling protocol. Data collected from this research activity provided several discrete types of information on the fishes of the San Juan River. Data that can be obtained on the endangered fishes of the river include determining approximate spawning period, identifying approximate location of spawning sites, and assessing effects of annual hydrology (and temperature) on their reproductive activities. Similar data could also be obtained for other members of the ichthyofaunal community and contrasted with previously drift-net sampling to assess the effects of that year's flow regime on fish reproduction. Samples collected during this research program were and will continue to be processed and curated by Fish Division personnel at the University of New Mexico.

Since the initiation of this research program, five larval Colorado pikeminnow have been collected. The two YOY Colorado pikeminnow collected in 1993 (at Mexican Hat) were the same length (9.2 mm TL; MSB 18098, 18099) and were taken on consecutive days in late July (26-27). From these two individuals, we determined the date of spawning to be about 8-9 July 1995.

Two larval Colorado pikeminnow were taken at Mexican Hat during the 1995 larval fish passive drift-netting study. The first specimen, 9.5 mm TL mesolarvae (MSB 26187) was taken between 2114-2310 hours on 2 August 1995. The next morning (3 August 1995) between 0531-0800 hours, a second Colorado pikeminnow, 9.0 mm TL mesolarvae (MSB 26191) was collected. The similar size and developmental stage of these two individuals, in combination with the fact that the two fish were collected within 12 hours of each other, strongly

suggest that they were cohorts from a spawning event. From these two individuals, a spawning date between 15-17 July was determined.

A single YOY Colorado pikeminnow was collected in 1996. That specimen was a 8.6 mm TL yolked-mesolarvae taken on 2 August 1996 in a drift net at the Mixer sampling locality (RM 128.0). That individual represents the only larval Colorado pikeminnow collected during drift net sampling at the Mixer. The 1996 back-calculated spawning date for Colorado pikeminnow (18 July 1996) was similar to that predicted in 1995 despite considerable difference in spring peak discharge (1995 - 12,100 cfs; 1996 - 3,450 cfs) and total annual discharge. The 1997 drift netting samples did not yield any Colorado pikeminnow and the 1998 Mexican Hat samples are still being processed (<200 bags of drift debris remain).

A comparison of 1995 and 1997 morning versus evening drift-net sampling indicated no significant differences in catch rate or ichthyofaunal composition. However, the supplemental data produced by evening sampling provided additional resolution to questions concerning drift patterns. In 1995, a drifting larval Colorado pikeminnow was collected during the evening of 2 August and an additional individual (larval) was collected the following morning (3 August). Given the relative rarity of target species in the San Juan River and the extremely limited number of larval Colorado pikeminnow and roundtail chub collected, we redesigned passive drift-netting protocol so that sampling can be conducted during both morning and evening. In addition, we instituted a sampling regime to be conducted during the last week of July or first week of August with nets to be set every other hour when hydrologic and weather conditions allow. All drifting larval Colorado pikeminnow were collected during this period.

Table 1. Summary of larval and YOY Colorado pikeminnow collected in the San Juan River during larval drift-netting (1993-1998) and back-calculated dates of spawning.

Field Number	MSB Catalog Number	Number specim.	Total Length	Date Collected	Date Spawned	River Mile	Sample Method
MH72693-2	18098	1	9.2	26 Jul 93	08 Jul 93	53.0	drift netting
MH72793-2	18099	1	9.2	27 Jul 93	09 Jul 93	53.0	drift netting
JPS95-205	26187	1	9.2	02 Aug 95	15 Jul 95	53.0	drift netting
JPS95-207	26191	1	9.0	03 Aug 95	17 Jul 95	53.0	drift netting
WHB96-037	29717	1	8.6	02 Aug 96	18 Jul 96	128.0	drift netting
TOTAL		5					

Study Area:

The two drift-netting stations for this study will be the San Juan River between RM 128 and Mexican Hat (RM 53). Under this scope of this project, we do not anticipate making any collections in the reach of the San Juan River under the jurisdiction of the National Park Service.

Objectives:

1. Determine the temporal distribution of San Juan River ichthyoplankton in relation to the hydrograph

2. Provide comparative analysis of the reproductive success of San Juan River fishes

3. Attempt to characterize downstream movement of ichthyoplankton

4. Attempt to validate presumed spawning period of Colorado River pikeminnow

5. Institute a short-term but intensive sampling regime in the proximity of the presumed Colorado pikeminnow spawning bed using the MEC as the principal collecting device.

Methods:

Daily drift samples will be collected at two predetermined localities (Four Corners and Mexican Hat) starting in early July and continuing until the end of August. Collections will be made using MEC each day at dawn and dusk for about two-hours. The amount of water filtered by each net (m^3) will be measured by mechanical flow-meters suspended in the center of the nets. This information (m^3) will allow us to determine catch per unit effort based on volume of water sampled versus time sampling. At the end of each sampling period, the collections will be labeled with unique field numbers and preserved in 5% buffered formalin.

All fish specimens will be identified and counted. In addition, specimens will be assigned to more coarse categories such as "drift" and "incidental". The former category refers to individuals with minimal or no control over their longitudinal movement. The latter classification refers to individuals whose developmental stage should have allowed them to avoid capture in passive drift nets.

Collection data will be converted to catch rate and compared across and within sites by species. In addition, catch rate between and within sites will be compared across time. Specimens will be distinguished and compared by residence status (native versus non-native) and catch rate over-laid with the annual hydrograph.

Products:

Separate draft reports for the 2001 passive larval drift sampling activities and collection efforts downstream of the putative spawning bar will be prepared and distributed by 31 March 2002 to the San Juan River Biology Committee for review. Upon receipt of written comments, that report will be finalization and disseminated to members of the San Juan River Biology Committee by 1 June 2002. Fish collected from those studies will be

curated in the Division of Fishes, Museum of Southwestern Biology (MSB), Department of Biology, at the University of New Mexico. Original field notes will be retained in the Division of Fishes and collection information will be electronically stored in a permanent MSB database program. Electronic copies of the field and collection data will be transferred to the San Juan River database manager following the successful protocol previously employed.

Budget:

Personnel	
Field Research Associate	$ 8,000
Field Research Technicians	$ 14,400
Subtotal	$ 22,400
Travel and per diem	
Travel	$ 2,160
Field per diem	$ 3,600
Subtotal	$ 5,760
Equipment and Supplies	
Equipment upkeep	$ 500
Sampling/Field Gear	$ 1,500
Laboratory Equipment/supplies	$ 1,000
Subtotal	$ 3,000
Total	$ 31,160
Overhead	$ 4,674
GRAND TOTAL	**$ 35,834**

San Juan River Larval Razorback Sucker Survey
Fiscal Year 2001 Project Proposal

Principal Investigators: Steven P. Platania
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and

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Background:

In 1994, the first series of razorback sucker (n=672) were stocked in the San Juan River between Bluff, Utah and the Hogback, New Mexico. Mean length and mass of those individuals, at the time of stocking, was about 400 mm TL and 710 g, respectively. In 1995, 13 of the recaptured razorback sucker were tuberculate males and six of those individuals were ripe. Four recaptured 1995 razorback sucker were determined to be female but, unlike the males, none were sexually mature. In their 1995 report of activities, Ryden and Pfeifer (1996) suggested that the majority of the experimentally stocked San Juan River razorback sucker reached sexual maturity in 1995-96 and that spawning of these individuals might begin in the next two years.

The UNM-NMGF larval fish drift study, whose primary focus was determining spawning period, identifying approximate location of spawning sites, and assessing effects of annual hydrology (and temperature) on Colorado pikeminnow reproductive activities, provided similar information for other members of the ichthyofaunal community. At the November 1996 San Juan River Biology Committee integration meeting, it was suggested that a portion of the larval fish drift study be expanded to allow for documentation of razorback sucker spawning. However, because reproduction by razorback sucker (March-May) occurred considerably earlier than Colorado pikeminnow (June-July), separate investigations of spawning periodicity and magnitude were necessary for each species.

The most significant potential difference identified between the two studies, besides temporal differences in spawning, was that we were attempting to provide the first documentation of reproduction by individuals (razorback sucker) whose spawning potential had not been determined. Sampling for larval razorback sucker was being conducted with no assurance that the stocked population of adult razorback sucker would spawn in this system. Conversely, we knew from previous studies that Colorado pikeminnow reproduction had and was

still occurring in the San Juan River and, because of this certainty, our larval fish sampling efforts for this minnow could be different than those for razorback sucker.

As numerous Upper Colorado River basin researchers had reported light-traps as one of the best means of collecting larval razorback sucker, we too elected to use that sampling procedure during the first year (calendar year 1997) of sampling. The only previous San Juan River fish investigation that employed light-traps was in 1994-1995 (conducted by the National Park Service) near the San Juan River-Lake Powell confluence. The 1994 sampling effort produced an extremely large number of larval fish (ca. 25,000) from a modest number of samples (n=20), of which over 99% were red shiner. Similar sampling in 1995 yielded 25,455 specimens in 47 light-traps samples and as in 1994, red shiner numerically dominated the catch. No Colorado pikeminnow or razorback sucker were taken in the 1994-1995 light-trap sampling efforts.

During the 1997 razorback sucker larval fish survey, light traps were set nightly in low-velocity habitats between Aneth and Mexican Hat from late March through mid-June 1997. The traps were distributed at dusk and retrieved about four hours later. Fish taken in those samples were preserved in the field. Sampling success during the 1997 razorback sucker larval fish study was quite poor. While there were over 200 light-trap sets, those sampling efforts produced only 297 fish. Of those, about 200 (66%) were larval suckers (either flannelmouth sucker or bluehead sucker). Larval razorback sucker were not present in the 1997 sampling survey. While there were probably several factors to account for the poor light trap catch rate, a principal factor was the limited access to suitable habitats. Light traps are most effective when set in habitats with little or no water velocity. During our driving survey of riverine habitats in the region (March 1997), we identified numerous locations that appeared to be suitable sites for light trap sampling. However, we found that high flow in the San Juan River eliminated virtually all previously identified low velocity habitats. Further driving reconnaissance failed to yield additional locations to set light traps. Being tied to specific collecting sites was not the most efficient means of collecting large numbers of individuals.

In 1998 we modified our sampling technique to allow for the sampling of a greater portion of the San Juan River and the collection of a significantly larger number of larval fish over a wider reach of the river. We conducted sampling forays (n=6) at approximately bi-weekly intervals from 17 April (first trip - no larval suckers) to 6 June 1998 between the Four Corners drift-net station (RM 128) and Bluff (RM 80) and used both active and passive sampling techniques to collect larval fish. The primary sampling method was a fine mesh larval seine (in 1998, we collected more larval sucker in a single seine sample than in all of the 1997 light trap samples). Passive sampling techniques were both drift-netting and the use of light-traps. Drift-nets were set periodically to determine if larval sucker comprised a significant portion of the drift community while light-traps were set adjacent to campsites if appropriate aquatic mesohabitats could be located. An inflatable raft was used to traverse this river reach and allow investigators the opportunity to sample habitats that were either not formerly accessible or observable under the constraints of the previous sampling protocol.

The 1998 sampling protocol resulted in the collection of over 13,000 specimens, the majority of which were larval catostomids. This 43-fold increase in number of specimens, as compared with 1997, provided substantially better resolution of spawning periodicity of the sucker community. In addition, the 1998 samples produced enough individuals for investigators to determine, with a high degree of confidence, if razorback sucker reproduction occurred in the San Juan River during that period. None of the aforementioned information

was obtainable from 1997 light-trap samples. In 1998, two larval razorback sucker were collected. These specimens provide verification of spawning by the re-established population.

Study Area:

The principal sampling area for this study will be the San Juan River between RM 128 and Mexican Hat (RM 53). We will attempt to make one or more sampling foray in 2001 between Mexican Hat (RM 53) and the Clay Hills boat landing (RM 2.9) just above Lake Powell in Utah. If conducted, this latter sampling effort would include making collections in reaches of the San Juan River under the jurisdiction of the National Park Service. Flow condition in 1999 were such that there were few low-velocity habitats available during the sampling period.

Objectives:

1. Determine the spawning periodicity of catostomids between mid-April-early June and examine potential correlations with temperature and discharge.

2. Determine if reproduction by razorback sucker occurred in the San Juan River (upstream of Mexican Hat, UT)

3. Provide comparative analysis of the reproductive effort of catostomids.

4. Attempt to validate presumed spawning period of San Juan River catostomids using data from the razorback sucker and Colorado pikeminnow larval fish studies.

Methods:

Sampling for razorback sucker larvae will be conducted in the San Juan River between Four Corners (RM 128) and Mexican Hat (RM 53) from mid-April through early June using sampling techniques that will provide sufficient number of individual fish necessary to meet study objectives. Access to the river shall be acquired through the use of either rafts or canoes. The tentative sampling schedule will be on a bi-weekly (approximately) interval.

Sampling efforts for larval fish will be concentrated in low velocity habitats. Samples in those habitats will be collected with small mesh seines and light-traps. Habitat type, length, maximum depth and substrate of the habitat will be recorded. For seine samples, length and number of each seine haul will be determined. Specimens will be preserved in the field for future laboratory processing. Catch per unit effort will be determined as the number of fish per m^2 sample for seine samples and the number of fish per hour for individuals collected in light-traps.

Catch rate data and compared across and within sites by species. In addition, catch rate between and within sites will be compared temporally (1997 & 1998 samples). Specimens will be distinguished and compared by residence status (native versus non-native) and catch rate over-laid with the annual hydrograph.

Products:

A draft report for the 2001 razorback sucker sampling activities will be prepared and distributed to the San Juan River Biology Committee for review by 31 March 2002.. Upon receipt of written comments, that report will be finalization and disseminated to members of the San Juan River Biology Committee 1 June 2002. Fish collected from this study will be curated in the Division of Fishes, Museum of Southwestern Biology (MSB), Department of Biology, at the University of New Mexico. Original field notes will be retained in the Division of Fishes and collection information will be electronically stored in a permanent MSB database program. Electronic copies of the field and collection data will be transferred to the San Juan River database manager following the successful protocol previously employed.

Budget:

Personnel		
Field Research Associate	$	8,000
Field Research Technician	$	5,000
Subtotal	$	13,000
Travel and per diem		
Travel	$	1,600
Field per diem	$	1,000
Non-Field per diem (meeting attendance)	$	500
Subtotal	$	3,100
Equipment and Supplies		
Rafting Equipment upkeep	$	2,000
Sampling/Field Gear	$	500
Laboratory Equipment/supplies	$	500
Subtotal	$	3,000
Total	$	19,100
Overhead	$	2,865
GRAND TOTAL	$	**21,965**

San Juan River Specimen Curation And Larval Fish Identification
Fiscal Year 2001 Project Proposal

Principal Investigators: Steven P. Platania and Alexandra M. Snyder
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Background:

Personnel from the Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico are responsible for two inter-related programs on the San Juan River. The Fish Division is the repository for specimens collected and retained by researchers. Fish taken under these programs are initially sorted by the principal investigator, held until they have submitted their yearly-progress report, and then received by MSB personnel. The collection is accessioned, specimens transferred from formalin to alcohol, identifications verified, individuals enumerated, length ranges recorded (largest and smallest specimen in a collection), collection data verified and transferred to wet labels, and incorporated into a database. Changes in species identifications are noted and returned to the principal investigator along with the entire data set (listing of collection locality, collectors, date, original field number, species, number of specimens, length ranges, and museum catalog number). In addition to performing duties associated with collections curation, we are also responsible for complete processing (sorting, identifying, counting, curating, and reporting) of selected San Juan River collections (larval drift netting samples, razorback sucker larval fish sampling, spawning bar fish collections). The samples (almost 600) generated by the aforementioned three studies resulted in the collection of over 20,000 larval fish during 1998 (this is an estimate as all samples have not been processed - at present we have sorted and identified over 15,000 larval fish).

In 1998, we processed almost 50,000 larval and juvenile fishes collected by the Utah Division of Wildlife Resources (during 1996) and University of New Mexico-N.M. Game and Fish researchers (during 1997). The 1998-99 Utah Division of Wildlife Resources and New Mexico Department of Game and Fish low-velocity habitat samples will be processed beginning in the summer 2001. As in the past, deviations in the identifications of those samples will be noted and forwarded to the principal investigators.

Study Area:

This project does not involve the collection of specimens but instead the processing and curation of samples gathered by the different research components of the San Juan River Research program. The collective sampling area for other researchers will be the San Juan River between Farmington and the Clay Hills boat landing (RM 2.9) just above Lake Powell in Utah.

Objectives:

1. Sort, identify, enumerate, and report on larval fish drift collections

2. Verify species identifications

3. Provide a permanent repository for San Juan River fish collections, field notes, and associated data

4. Assist principal investigators with collection sorting and identifications

Methods:

Larval fish drift collections generated by UNM-NMGF research projects (Colorado pikeminnow drift-netting study, razorback sucker larval fish survey, Colorado pikeminnow spawning bar larval fish sampling) are received unsorted and processed as stated above. In addition to recording the length ranges for each species in each collection, we also note the presence of larval, juvenile, and adult specimens in the samples. The annual report for the larval fish portion of the study will be prepared by UNM personnel, as it has been since 1995.

We have assisted principal investigators by taking on the responsibility of processing unsorted collections. Specimens are sorted, identified, counted, measured, catalogued, and data submitted to the principal investigator for inclusion in reports. In the past, this work has had to be done on relatively short notice.

Samples from projects are received after the principal investigator has completed their work and prepared the necessary annual report. This means that there will be a lag of one year in reference collection of specimens and processing of those samples. All collections are matched with the appropriate data-sheet, transferred from formalin to alcohol, stored in museum quality jars, re-identified, counted, measured (range), labeled, and catalogued into the permanent MSB Fish Division collection.

Products:

A draft report of the 2001 San Juan River specimen curation and larval fish identification sampling activities will be prepared and distributed by 31 March 2002 to the San Juan River Biology Committee for review. Upon receipt of written comments, that report will be finalization and disseminated to members of the San Juan River Biology Committee 1 June 2002. Fish collected from this study will be curated in the Division of Fishes, Museum of Southwestern Biology (MSB), Department of Biology, at the University of New Mexico. Original field notes will be retained in the Division of Fishes and collection information will be electronically stored in a permanent MSB database program. Electronic copies of the field and collection data will be transferred to the San Juan River database manager following the successful protocol previously employed.

Budget:

Personnel	
Research Associate	$ 20,000
Laboratory Technician	$ 7,200
Subtotal	$ 27,200
Travel and per diem	
Travel	$ 600
Per diem	$ 450
Subtotal	$ 1,050
Equipment and Supplies	
Laboratory Equipment/supplies	$ 2,000
Computer supplies	$ 1,000
Subtotal	$ 3,000
Total	$ 31,250
Overhead	$ 4,688
GRAND TOTAL	**$ 35,938**

Long Term Monitoring - Channel Morphology
Fiscal Year 2001 Project Proposal

Principal Investigator: Ron Bliesner
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Study Area:

The study area consists of the San Juan River and its flood plain from RM 180 (Farmington, NM) to RM 3 (Clay Hills Crossing).

Collections:

There are no collections associated with this study.

Background:

There are presently 25 river transects that have been established between RM 180 and RM 3 in the San Juan River for purposes of measuring channel scour and deposition. Additionally, substrate composition (sand or cobble/gravel) has been identified during each survey. These cross-sections have been surveyed before and after runoff since 1992. The data from these surveys was used to examine channel scour and deposition, determine change in channel capacity and track change in substrate material. Flow statistics for 8,000 cfs flows were based, in part, on these data.

Maintenance of cobble bars with open interstitial space has been determined to be important for spawning of Colorado Pikeminnow. Four of the sites (RM 173.7, 168.4, 132, 131) that have been identified in the San Juan River as having characteristics suitable for spawning have been monitored since 1995. The results of the surveys at this site were used as part of the basis of the flow recommendation at 8,000 cfs. To verify or adjust this recommendation, these sites will continue to be monitored.

The flow-habitat area model for backwaters is based on the ability of the channel to clean sediment from the system and the rate at which the sediment accumulates in the backwaters after runoff. The amount of perturbation (loss of habitat) due to summer and fall storms has been estimated based on analysis of habitat area data collected before and after storm events. Equivalent data on change in depth of backwaters and depth of sediment have not been analyzed. It is proposed that sediment depth and water depth be measured in backwaters twice yearly at the end of runoff in late July or early August and again in October to assess change. The second sampling will be completed during the fall habitat mapping exercise.

Objectives:

1. River Geometry Monitoring: Determine short term and long term change in river cross sections at key locations and the relationship of this change to spring runoff and summer/fall storm events.

2. Cobble Bar Monitoring: Determine short term and long term change in cobble bar characteristics in response to spring runoff and summer/fall storm events.

3. Backwater Perturbation Monitoring: Monitor effect of spring runoff and summer/fall storm events on sediment accumulation in backwaters and backwater depth.

Methods:

1. River Geometry Monitoring: The 14 cross-sections identified in 1999 as part of the long term monitoring plan will be surveyed pre- and post-runoff for analysis of annual change and compared to previous surveys to determine trends. Analysis of the change in cross-section geometry and substrate in relation to hydrographic conditions will be completed to monitor response of the system to flow recommendations.

2. Suspended Sediment Analysis: Continuous turbidity monitors are installed at Shiprock, New Mexico and Montezuma Creek Bridge, Utah. The data will be used to qualitatively assess sediment transport in relation to the flow regime, in addition to identification of storm events.

3. Cobble Bar Monitoring: Maintenance of cobble bars with open interstitial space has been determined to be important for spawning of Colorado Pikeminnow. Four sites (RM 173.7, 168.4, 132, 131) have been identified in the San Juan River as having characteristics suitable for spawning. These sites have been monitored since 1995. The results of the surveys at this site were used as part of the basis of the flow recommendation at 8,000 cfs. To verify or adjust this recommendation, these sites will continue to be monitored per the long range monitoring plan.

   Topographic surveys will be completed for each of the sites utilizing total station or gps survey equipment with control provided by the established bench marks at each site. Surveys will be completed as soon as practical after spring runoff, usually during the end of July or early August. The same area will be surveyed each year to allow comparison to previous years.

   At the same time, the structure of the bar will be assessed by completing point counts of the surface bed material (n=200 per sample or more) at each bar. Particles will be selected by the point count method over the full extent of the bar within the survey boundary. Size is determined by placing the rocks through a square hole in an aluminum plate, cut to represent an equivalent screen size from 1 cm through 10 cm at 1 cm increments, then 2 cm increments through 20 cm. Those larger than 20 cm are recorded as greater than 20 cm. Interstitial material smaller than 1 cm is not recorded.

Depth of open interstitial space (depth to embeddedness) will be measured on a 5 or 10-ft grid over the extend of the bar. Measurement will be made by working a hand between rocks until the fingers touch the sand embedded depth. The depth of penetration below the average top of cobble immediately adjacent to the sample point will be measured and recorded as the depth of open interstitial space.

Change in bar morphology will be determined by producing three-dimensional plots of the surveyed surface and subtracting the resulting surface from the surface generated from the previous survey. The amount of change will be correlated to the flow conditions for the year.

The size distribution of cobble at each bar is computed and the D_{16}, D_{50} and D_{84} sizes reported and compared to previous years. Depth of open interstitial space will be computed as actual depth and multiples of mean cobble diameter.

4. Backwater Perturbation Monitoring: To characterize the relative quality of backwaters, five representative backwaters within each geomorphic reach will be measured for water and sediment depth. Measurements will be made annually between September 15 and Nov 1 per the long term monitoring plan. These sites will remain the same from year-to-year to the extent possible. If a backwater is "lost," another will be selected for sampling and retained in the sampling regime until it is lost. Depth of sediment will be measured and recorded for "lost" backwaters. All measurements will be made at flows between 500 and 1,000 cfs, if possible, and at the same flow from year-to-year, if possible. Sediment and water depths will be measured at three points in each backwater (mouth, 1/3 and 2/3 of length). The backwaters sampled will be marked on digital aerial imagery.

   Storm events will be determined by changes in flow and turbidity at USGS gages located near Shiprock and Montezuma Creek.

   The annual report will include a summary of backwater measurement data for each site, including site location, water and sediment depth, flow at sampling, flow and turbidity data. Every five years the runoff/storm event/backwater habitat relationships will be analyzed.

Products:

An annual report and data files for inclusion in the GIS database will be produced under this task. The annual report will include a summary of backwater measurement data for each site, including site location, water and sediment depth, flow at sampling, flow and turbidity data.

Budget (Funded by BIA):

Category	Cost
Labor	$ 95,410.00
Travel, per diem	$ 14,445.00
Vehicle/Equipment Use	$ 1,930.00
Supplies	$ 2,500.00
Overhead	$ 746.00
TOTAL	**$ 115,031.00**

Habitat Mapping
Fiscal Year 2001 Project Proposal

Principal Investigator: Ron Bliesner
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and

Principal Investigator: Vince Lamarra
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Study Area:

The study area consists of the San Juan River from RM 180 (Farmington, NM) to RM 3 (Clay Hills Crossing).

Collections:

There are no collections associated with this study.

Background:

Habitat mapping completed during the period 1992 - 1997 has been used to develop flow/habitat relationships used in the flow recommendation process. To verify and refine these relationships and examine long term trends, habitat mapping will be continued on an annual basis during the low flow period in the fall per the long range plan.

Objectives:

1. Main River Habitat Mapping: Map San Juan River habitat from RM 180 to RM 0 during September-October. This objective is a continuation of the 2000 work as described in the long term monitoring program.

2. Digitize and process data utilizing GIS: Habitat mapping data will be digitized and entered into the ArcCAD system.

Methods:

1. Habitat mapping (San Juan River): One flight to collect digital aerial photography or videography will be completed for the San Juan River from RM 180 to RM 0 and printed at an approximate scale of 200 ft/inch. Thirty-eight categories of aquatic habitat will be mapped in the field utilizing the digital imagery as a base map. The flights and mapping will be completed as soon after runoff as flows reach 1,000 cfs or less and weather will allow. Field mapping will be completed at flows between 500 and 1,000 cfs if possible.

   Two of every three miles will be mapped through the full reach, corresponding with the miles designated for sampling under the other long term monitoring plans.

2. Digitize and process data utilizing GIS: Upon completion of each habitat mapping program (Objectives 1 and 2), the field maps will be rectified and digitized into ArcCAD.

Products:

An annual report and GIS coverages for inclusion in the GIS database will be produced under this task. The annual report and coverages will be for the 2000 mapping. Reporting for the 2001 mapping will be in the 2002 budget.

Budget (Funded by BIA):

Category	Cost
Labor	$ 42,960.00
Travel, per diem	$ 3,250.00
Vehicle/Equipment Use	$ 700.00
Supplies	$ 1,187.00
Overhead	$ 2,375.00
TOTAL	**$ 50,472.00**

Water Temperature Monitoring
Fiscal Year 2001 Project Proposal

Principal Investigator: Ron Bliesner
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Study Area:

Temperature recorders are installed from RM 224 (Navajo Dam) to RM 92.5 (Montezuma Creek Bridge).

Collections:

None.

Background:

Water temperature recorders were installed in 1992. This work element is a continuation of the original work, with station servicing and data extraction.

Objective:

Collect Water Temperature Data at 7 locations

Methods:

Collect Water Temperature Data at 7 locations: Temperature recorders are located at Navajo Dam, Archuleta, Farmington, Shiprock, Four Corners and Montezuma Creek and on the Animas River at Farmington. These recorders will be serviced twice and the data extracted and plotted for the annual report.

Products:

An annual report and data files for inclusion in the GIS database will be produced under this task.

Budget (Funded by BIA):

Category	Cost
Labor	$ 5,595.00
Travel, per diem	$ 270.00
Vehicle/Equipment Use	$ 200.00
Supplies	$ 200.00
Overhead	$ 0.00
TOTAL	**$ 6,265.00**

Water Quality Monitoring
Fiscal Year 2001 Project Proposal

Principal Investigator: Ron Bliesner
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Study Area:

Water samples will be taken at 12 locations along the San Juan River or tributaries between RM 219 (Archuleta) and RM 52 (Mexican Hat).

Collections:

Water samples only

Background:

Monthly water samples during 1991-1998 have been collected at about 30 different sites in the San Juan River and its tributaries within the study area. The results of the water-quality analyses have shown that most concentrations are replicated between months and among nearby stations. The results of these analyses were used to identify the stations, set the timing and parameters of analysis.

Objective:

Collect Quarterly Water Samples at 12 locations.

Methods:

Collect Quarterly Water Samples at 12 Locations: Depth integrated water samples will be collected at the 12 locations listed in Table 1. Samples will be taken quarterly in February, May, August and November of each year near mid-month. The chemical analyses most relevant to the long-term monitoring goals are listed in Table 2. The concentration of the parameters listed in the first column will be determined every sampling period. In addition field measurements of temperature, pH, redox potential, electrical conductivity and dissolved oxygen will be taken. Annually, during low flow periods in February, the water samples should analyzed for all the parameters listed in Table 2. Field data collection and laboratory analysis will be completed by standard EPA methods, where applicable.

Table 1. Proposed Sampling Stations along San Juan River between Navajo Dam and Mexican Hat.

Station Name	Station ID	USGS Sampling In Period	BIA Sampling Period
SAN JUAN RIVER NR ARCHULETA BRIDGE	9355500	1958-1984	1991-1998
GALLEGOS CANYON NR FARMINGTON, NM	9357255	1979-1981	1991-1998
ANIMAS RIVER AT FARMINGTON, NM	9364500	1958-1992	1991-1998
SAN JUAN RIVER AT FARMINGTON, NM	9365000	1974-1991	1991-1998
LA PLATA RIVER NR FARMINGTON, NM	9367500	1977-1991	1994-1998
OJO AMARILLO CANYON	9367536		1993-1998
SAN JUAN RIVER AT SHIPROCK, NM	9368000	1958-1992	1991-1998
MANCOS RIVER NR FOUR CORNERS	9371005		1991-1998
SAN JUAN RIVER AT FOUR CORNERS, CO	9371010	1977-1990	1991-1998
SAN JUAN RIVER AT MONTEZUMA CREEK BRIDGE	9378610		1991-1998
SAN JUAN RIVER AT BLUFF BRIDGE (HIGHWAY 191)	9379495		1991-1998
SAN JUAN RIVER NR BLUFF, UT (AT MEXICAN HAT)	9379500	1974-1993	1991-1998

Table 2. Water quality parameters for analysis

Quarterly	Annually
Arsenic (total and dissolved)	Aluminum (total and dissolved)
Calcium (dissolved)	Barium (total and dissolved)
Copper (total and dissolved)	Manganese (total and dissolved)
Lead (total and dissolved)	Nickel (total and dissolved)
Magnesium (dissolved)	Potassium (total and dissolved)
Mercury (total and dissolved)	Strontium (total and dissolved)
Sodium (dissolved)	
Selenium (total, dissolved, total recoverable)	
Zinc (total and dissolved)	Chloride (dissolved)
	Ammonia (dissolved)
Alkalinity(HCO_3)	Nitrate (dissolved)
Hardness	Nitrite (dissolved)
TDS	Silica (total and dissolved)
TSS	Sulfate (dissolved)
Turbidity	Orthophosphate (dissolved)

Products:

An annual report and data files for inclusion in the GIS database will be produced under this task.

Budget (Funded by BIA):

Category		Cost
Labor	$	4,520.00
Travel, per diem	$	1,000.00
Vehicle/Equipment Use	$	900.00
Supplies	$	15,000.00
Overhead	$	1,500.00
TOTAL	**$**	**22,920.00**

GIS Based Integrated Database Maintenance
Fiscal Year 2001 Project Proposal

Principal Investigator: Ron Bliesner
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Study Area:

The study area for this task is for the San Juan Basin below Navajo Dam.

Collections:

None.

Background:

In 1996 a GIS database was developed to provide a tool for compiling, maintaining and analyzing all data collected as a part of the San Juan River Basin Recovery Program. All updates will be coordinated through FWS-Region 2, the main repository for the data.

Objective:

Update and Maintain GIS Database.

Methods:

1. Prepare Standardized Data Formats: Utilizing data provided in the past, each researcher will be provided a requested data format for data inclusion to match previous data sets. For new data sets, the format will be developed based upon researcher input.

2. Update and Maintain GIS Database: Datasets provided by each researcher will be added as coverages to the existing GIS database. A CD-ROM will be produced and distributed to researchers by June of each year containing data collected in all previous years. For inclusion, data must be received by March 31. All updates will be coordinated through FWS-Region 2, the main repository for the data.

Products:

A CD-ROM containing all data supplied by researchers by the cutoff date will be produced and copies distributed to all researchers.

Budget (Funded by BIA):

Category	Cost
Labor	$ 24,112.00
Travel, per diem	$ 0.00
Vehicle/Equipment Use	$ 0.00
Supplies	$ 1,000.00
Overhead	$ 1,160.00
TOTAL	**$ 26,272.00**

II. Program Reporting Proposals

Peer Review for 2001
Fiscal Year 2001 Project Proposal

Principal Investigator: Paul B. Holden
BIO/WEST, Inc., Logan, Utah
Jicarilla-Apache Tribe
(435) 752-4202 pholden@bio-west.com

Background:

During 1997 a Peer Review Panel was established that included the following scientists:

Dr. Clark Hubbs - Fishery ecologist and professor emeritus from the University of Texas. Clark served on the Peer Review Panel for the Grand Canyon Environmental Studies.

Dr. Peggy Shute - Endangered Fish Biologist with TVA who is actively working on similar endangered species issues in the eastern U.S.

Dr. David Galat - Fishery Ecologist with the National Biological Survey and Missouri Cooperative Fishery Unit who is working on native fishes and instream flow issues on the Missouri River.

Dr. Ellen Wohl - Associate Professor in the Department of Earth Sciences at Colorado State University. Ellen has been involved with peer review of Upper Colorado River Basin projects and has expertise is geomorphology and sediment transport.

Dr. Ron Ryel - Biostatistician and ecologist with experience in population modeling. Ron has been involved with endangered fish issues in the Grand Canyon and the Upper Colorado River Basin.

Dr. Shute was unable to work on the panel in 1997 due to ill health and resigned from the panel in 1998 because of workload considerations. The other four members of the panel participated in meetings in 1997 where the flow recommendations were discussed, and continued involvement in the flow recommendation report process by commenting on the pre-draft report and attending a Biology Committee meeting to discuss the pre-draft report in 1998. They also met with the Biology Committee in 1999 to discuss the draft flow recommendation report that the Biology Committee sent to the Coordination Committee for review. In addition, in 1999 the Peer Review Panel reviewed the draft Monitoring Plan, and initial drafts of the final research reports.

In 2000, the Peer Review Panel reviewed and commented on the final research reports, the long term monitoring plan, and the Program Evaluation Report.

In 2001, the Peer Review Panel will be used to interact with the Biology Committee during consideration of the Long Range Plan, meeting with them one or two times during the fiscal year, and reviewing documents as they are produced.

This proposal provides for funding to maintain the Peer Review Panel activities during 2001.

Goal:

The goal of peer review is to provide additional scientific oversight over San Juan River Recovery Implementation Program technical studies and reporting. The Peer Review Panel will work with the Biology Committee to produce scientific credible documents and will assist the Biology Committee in maintaining a highly scientific direction to the Program.

Methods:

The Peer Review Panel will meet with the Biology Committee on an as needed basis, but likely no more than two times during 2001. One of these meetings will be the winter meeting when results of ongoing studies and plans for the following year are discussed. They will also review Program reports when they are in draft and final form, including the Long Range Plan. Studies planned for 2001 include an augmentation plan for Colorado pikeminnow and the final bioenergetics model. These items will be peer reviewed also. Their reviews will be provided to the Biology Committee through Dr. Paul Holden in letter form, and through discussions at the Biology Committee meetings. Biology Committee researchers may call Peer Review Panel members to ask for advice, and Peer Review Panel members may call Biology Committee researchers if they have questions concerning Program activities. All correspondence between the Biology Committee and the Peer Review Panel will be coordinated through Dr. Paul Holden, who will maintain a record of these coordination activities for the Program. Additional Peer Review Panel members may be added if a particular expertise is needed by the Biology Committee.

Products:

Peer review participation at 2 meeting and letter reports from each peer reviewer.

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Budget:

Payment for serving on the Peer Review Panel includes expenses for travel to and from meetings, and for non-federal personnel (Hubbs, Wohl, Ryel) an honorarium. The honorarium would be sized dependent on the activities of the Peer Reviewer. The budget for 2001 is expected to be similar to costs incurred in 2000, which were approximately $8,000.

Honoraria:	$ 5,000
Travel:	$ 3,000
Total	**$ 8,000**

Funds remaining from 2000 are sufficient to cover the 2001 budget (Approximately $8,000 is remaining)

III. Research Proposals

Evaluation of the Effect of Elevated Flows on Spawning Success of Red Shiner, *CYPRINELLA LUTRENSIS*
(Year 4 of 4)
Fiscal Year 2001 Project Proposal

Principal Investigator: David L. Propst
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and

Principal Investigator: Steven P. Platania
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Study Area:

Study sites are located on secondary channels of the San Juan River at RM 136 and 128.5

Collections:

Specimens collected will be inspected to determine if any rare fishes (Colorado pikeminnow, roundtail chub, and razorback sucker) are present in the seine. Any rare fish >150 mm TL and all large-bodied native fish (i.e., flannelmouth and bluehead suckers) will be released. All other specimens will be preserved in 10% formalin and returned to the New Mexico Department of Game and Fish Laboratory for identification, enumeration, and measurement (total length and weight).

Background:

The red shiner, *Cyprinella lutrensis*, is native to central and southern Great Plains streams of the Mississippi-Missouri and Gulf Coastal drainages (Matthews, 1980). It was first documented in the Colorado River basin near Yuma, Arizona in 1953 (Hubbs, 1954). Since then, the species has become widespread and common in the basin and has been implicated in the decline of several native fishes (Minckley and Deacon, 1968; Douglas et al., 1994; Ruppert et al. 1993). In the San Juan River of New Mexico, Colorado and Utah, red shiner is one of the most common nonnative fish species, particularly in low velocity habitats (Archer et al., 1996; Propst and Hobbes, 1996). These low velocity habitats (backwaters and embayments) are also important nursery areas for larval Colorado pikeminnow (Haynes et al., 1984; Archer et al., 1996). Low numbers of larval (Age 0) Colorado pikeminnow have been captured during most years (1992-1996) of the San Juan River primary

channel (Archer et al., 1996). Although San Juan River secondary channels, after cessation of spring runoff, have mainly low-or zero-velocity habitats, no larval Colorado pikeminnow was captured in secondary channels prior to 1996 (Propst and Hobbes, 1996).

In November 1996 and August 1997, large numbers of Age 0 Colorado pikeminnow and smaller numbers in August 1998 were stocked in the San Juan River in an effort to determine what factors might be limiting recruitment of young Colorado pikeminnow to the adult population (UDWR 1998 Work Plan). Following their stocking, UDWR personnel regularly sampled low velocity habitats to assess Age 0 Colorado pikeminnow survivorship and characterize the habitats they used (E. Archer, pers. comm.). In addition to being found in low-velocity habitats associated with the primary channel, stocked Colorado pikeminnow were also found in secondary channels. During the autumn 1997 secondary channel monitoring, 240 Age 0 Colorado pikeminnow were found in 20 secondary channels. In August 1998, a single Colorado pikeminnow (ca. 140 mm TL) was captured at the Channel from Hell study site.

In the San Juan River, backwater habitats associated with the primary channel, typically represent a small proportion of the total wetted area available as habitat to fishes (Bliesner and Lamarra, 1996). After cessation of spring runoff, secondary channel habitats are primarily low-velocity and provide comparatively large (surface area) potential nursery habitat for Colorado pikeminnow. Prior to stocking Age 0 Colorado pikeminnow in 1996, the apparent absence of the species in secondary channels may have been precluded by the high abundance of nonnative fishes, particularly red shiner. One possible explanation for the high abundance of red shiner in secondary channel habitats (as well as primary channel backwaters) is the ability of an individual female to spawn numerous times over a season, if water temperatures are within the appropriate range (>25 and <35°C; Gale, 1986). Red shiner spawning in San Juan River secondary channels was noted at temperatures between 20 and 25°C (D. L. Propst and K. B. Gido, unpublished data), but most spawning appeared to occur when water temperature was within the range reported by Gale (1986). If red shiners have an extended spawning season in San Juan River secondary channels, this should be reflected in the capture of small larvae (<12 mm SL) for an extended time (ca. 60 to 80 days). However, data from intensively sampled secondary channels indicated that the spawning season for red shiner in the San Juan River is brief. At the Channel from Hell (RM 136) site, Age 0 red shiners were first collected in late-July 1993 and 1994. Length-frequency histograms indicated that the 1993 spawning likely occurred from the second or third week of July through early September (ca. 60 days), but that most spawning occurred during a brief period in late July-early August (ca. 15 days). Data from 1994 indicated that most spawning occurred over a similar or briefer time frame. Fewer red shiner specimens were collected in 1995, but data for that year also suggested a brief spawning season. Greatest density of red shiner at the Channel from Hell site occurred in 1993 when discharge in the channel was very low throughout the presumed spawning season. Spring runoff in 1994 was comparatively low and red shiner density increased with successful spawning and recruitment. In 1995, high spring runoff apparently decreased red shiner density and reduced spawning success. Water temperatures at the Channel from Hell site exceeded 25EC for only 3 weeks or less in 1993, 1994, and 1995. Although Gale (1986) found a strong correlation between red shiner spawning and water temperature and such appears to be indicated by the foregoing data, photoperiod may also influence time of maximum spawning activity (C. Hubbs, pers. comm.).

The above provides evidence to support the contention of Gido et al. (1997) that spring runoff tends to reduce the abundance of nonnative fish in secondary channels. However, even high spring runoff does not eliminate nonnatives. The survivors spawn, and can potentially regain abundance (presumably as a consequence of increased survivorship of Age 0 fish) similar to that prior to high spring runoff.

Although high spring runoff appears to be an important factor in suppressing nonnative abundance, data on the red shiner population in the Channel from Hell suggest it is sufficient only for temporary and short term reductions. Given the documented problems that red shiner (as well as other nonnative fishes) present to native fishes, particularly those that use low-velocity nursery habitats, additional means to suppress nonnative abundance are needed. The data from the Channel from Hell site suggest that flow spikes during the spawning season of red shiner (preferably in concert with high spring runoff) would contribute to reduction or suppression of abundance of the species. A correctly-timed flow spike (natural or human-caused) would reduce water temperature below optimal spawning temperature and flush larval red shiner from nursery habitats. Ideally, this reduction would be sufficient to reduce red shiner sufficiently that it would not be a problem for larval Colorado pikeminnow the following year.

A potential problem with a flow spike of sufficient intensity to reduce red shiner spawning success would be its occurrence when larval Colorado pikeminnow are susceptible to displacement. Conversely, if survival of larval Colorado pikeminnow is impaired by high densities of red shiner, a flushing or spawn-delaying flow spike would not diminish the ultimate survival of Colorado pikeminnow in the San Juan River. Red shiner is a short-lived species (maximum longevity <30 months) and populations of such species must successfully spawn at least every 2 years to survive. Colorado pikeminnow, however, is a long-lived species (>25 years) and may not have to spawn successfully each year to maintain population viability.

The results of a study such as that proposed herein have implications for the management of undesirable nonnative fishes. If summer flow spikes are demonstrated to have deleterious effects upon red shiner density, particularly in low-velocity habitats, a management option may be to make reservoir releases to mimic summer storm caused flow spikes. A critical issue for such a management option is the volume of water needed to cause the desired effect. This study is designed to identify the threshold flow spike (and thus the volume of water) sufficient to significantly reduce red shiner abundance. During "dry" years, a decision may be made to not use limited water supplies to mimic spring runoff, but to use the available water to reduce red shiner abundance during their spawning season.

Objective:

The overall study objective is to determine if summer storm-caused flow spikes significantly reduce red shiner spawning success and abundance. Data from this study will be used to evaluate the efficacy of using summer reservoir releases to reduce red shiner abundance.

The specific objectives of the study are:

1. Document the response (spawning success and survival of larvae) of red shiner to elevated flows during its spawning season.

2. Estimate the volume and duration of elevated flows required to have a demonstrable negative impact on red shiner spawning success and abundance.

3. Characterize response of other nonnative and native fishes to elevated flows at each study state.

4. Prepare report (using appropriate uni- and multivariate statistical procedures) detailing results of study and use this information to make recommendations to improve the management of nonnative fishes particularly red shiner, in the San Juan River.

Methods:

Study sites are located on secondary channels at RM 136 and 128.5 (also used in the Gido et al.,1997 and Gido and Propst, 1999, studies). Each site contains a representative mix of mesohabitats (e.g., pools, riffles, and runs). Thermographs were installed at each site prior to cessation of spring runoff. During 1998, 1999, and 2000 each site was sampled weekly from the date Navajo Dam releases reached base summer releases (typically mid-June) through 30 September. Sampling was done by mesohabitat, following the protocol of Gido et al. (1997). All specimens were preserved (10% formalin), measured (± 1 mm TL), and a subsample of female and male red shiners collected at each site will be examined to characterize gonadal conditions. A minimum of 10 mesohabitats were sampled at each site on each date. Specimens collected from each mesohabitat were preserved separately. Surface area, mean depth, and mean water velocity were determined for each sampled mesohabitat. If flows were sufficient, secondary channel discharge was determined on several occasions for each secondary channel. Time of maximum spawning activity will be related to accumulated degree-days and photo-period.

During each year of the study, natural flows were depended upon to assess their relative impact on red shiner spawning and recruitment success. The weekly sampling schedule ensured that sampling occurred within a few days of any natural flow spike.

For each year of the study, optimal study conditions would include a range of natural summer flow spikes during the presumed peak spawning season of red shiner, However, absence of a flow spike in a particular year would not negate the value of the data collected. A continuum of summer flow patterns from no flow spike through one as high as that during summer 1997 would enable enhanced resolution of the relationship between summer flows and red shiner abundance.

Field work was proposed and conducted for 3 years. This year (2001) will be the fourth year of the study. Data compilation, data analysis, and report preparation will be completed during this, the final year of the study. To date (August 2000) total lengths have been determined for all specimens collected from each site in 1998 and 1999. These data have been electronically recorded. All temperature data collected by thermographs at each site in 1998 and 1999 have been compiled.

Data will be compiled annually by secondary channel by species. Primary analyses will involve weekly length-frequency characterization of red shiner and other commonly collected species (fathead minnow and speckled

dace). Information from length-frequency histograms (2 mm length-classes) will enable approximation of initiation and completion of spawning season. Histograms will also enable estimation of growth rates and survival of red shiner (and other common species). Discharge and thermal data will be compared with age-class and density (number/m^2) information to characterize response of red shiner to flow attributes. In addition to data collected during this study, that obtained during 1996 through 1998 (Gido et al., 1997 and Gido and Propst, 1999) secondary channels studies will be used, where appropriate. Analysis of effect of flow spikes on red shiner reproduction and recruitment initially will be graphical. However, if more sophisticated analyses, such as regression or analysis of variance are deemed appropriate, such will be used. Nonparametric tests (e.g. Kolomogorov-Smirnov) will be used to compare weekly size-structure characterizations of red shiner and other common species. Grossly, total red shiner weekly abundance will be regressed with discharge. This method, however, provides little insight to interplay of discharge (and associated water temperature), reproduction, Age 0 survival, and total red shiner density. Multivariate methods will be used to analyze abundance of red shiner and its relation to various flow attributes.

A subsample of female red shiner from each collection will be eviscerated to estimate fecundity and characterize reproductive readiness. This information will be compared to temperature data to evaluate the effect of ambient water temperature (and by implication discharge) on timing and duration of red shiner reproduction. Somatic attributes of male red shiners will also be used to characterize duration of spawning season.

All collections were made by mesohabitat. Quantified habitat data will be compiled to characterize the mesohabitats occupied during the spawning season of red shiner and to determine if there is gender-based habitat selection. These data will also be used to characterize ontogenetic shifts in habitat use.

Although the primary focus of this study is to characterize the response of red shiner to summer flow spikes, the sampling methodology enables collection of data on all species (native and nonnative) that inhabit secondary channel habitats during summer. These data also will be analyzed to provide insights to the response of these species to summer flow spikes.

Products:

A Draft Final Report and electronic data files will be provided by 1 October 2001 to the SJRIP Biology Committee. The final report, in scientific journal style, will be completed by 1 January 2002. In addition to reporting the results of the study, the report will include recommendations for using flow manipulation to control or suppress red shiner abundance in the San Juan River.

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Budget:

Data synthesis and analyses		
Personnel	$	25,000
Report preparation		
Personnel	$	10,000
Administrative Support	$	2,000
Total	$	37,000
Indirect Costs (10 %)	$	3,700
Total	**$**	**40,700**

[1]Budget does not include in-kind contributions.

Population Estimates for San Juan River Fish and Primary/Secondary Productivity Data for Use in Population Model Refinements Fiscal Year 2001 Project Proposal

Principal Investigators:
Vince Lamarra
Ecosystems Research Institute, Logan Utah
and
Bill Miller
Miller Ecological Consultants, Fort Collins, Colorado

Background:

A modeling effort to construct a conceptual framework for the fish community and endangered fishes in the San Juan River began in 1998. This effort relates to Sections 5.1; 5.1.1; 5.1.2; 5.1.3.; 5.1.4 of the Long Range Plan. These models have helped direct a focused field effort with the intent of using key site specific data to determine the carrying capacity of pike minnows and razorback suckers in the river.

That models as proposed includes bioenergetics, population, and trophic components. Data for fish populations by age class and habitats as well as other trophic components are required as model parameters. The intent of the 2001 program is to better parameterize structural and functional components of these conceptual models. Three approaches are currently under investigation each of which is centered on a different hierarchical organization. They are:

A. BIOENERGETICS This approach is individual based (structural) and summed for population effects .In addition, functional energetic (ingestion/egestion, assimilation, etc.) Are considered.

B. POPULATIONS This conceptual approach utilizes densities/biomass, size/age structure, etc of individual populations. The populations sizes will be tiered to habitats and habitat requirements.

C. TROPHIC STRUCTURE An attempt is being made to understand the food web structure of the river based upon functional groups. This approach utilizes biomass estimates at all trophic levels and will look at the movement of energy and biomass between trophic groups (IE grazers, detritivores)

Population estimate – relative abundance correlation

That model formulation effort is ongoing and included a one week effort to make population estimates for the San Juan River fish community at the upper and lower reaches of the expected inhabited range for the Colorado pike minnow. The population estimates were made using multiple pass removal techniques within specific habitat types and for a one mile reach of river using raft mounted electrofishing equipment. The habitat specific electrofishing was conducted using a barge mounted 5.0 GPP Smith-Root multiple electrode array. Habitat specific collections used blocknets and bag seines to delimit the electrofished areas.
The results of that effort show that population and biomass estimates with reasonable confidence intervals can be obtained using the above methods. Specific population estimates by size class (YOY, juvenile and adult) will be made using the data obtained at the three river reaches. This additional population effort is intended to

provide additional information for use in refining the correlation between population estimates and relative abundance data.

Population dynamics of lotic fish communities are largely a function of the condition of and changes in their physical environment and the resulting responses in both primary (phytoplankton and periphyton) and secondary (zooplankton, micro-and macro invertebrates) production, and upon which these fishes rely to varying degrees for forage. Although the importance of these relationships are universally recognized by fisheries researchers, these lower trophic levels and the physical processes which influence them are often poorly understood in many aquatic systems. Yet these physical (substrate characteristics, temperature, water transparency, dissolved oxygen, etc.) and biological components of the ecosystem form the framework within which fish populations exist and function. In the San Juan and Animas Rivers, these factors are highly influenced by the flow regime associated with the annual spring runoff as well as summer storm events. This influence of the flow regime makes the study of these physical and biological components of the ecosystem especially relevant in rivers where the management of flow is considered vital to the health of t of fish population of concern.

Studies conducted by Ecosystems Research Institute in the San Juan River (Bliesner and Lamarra 1996, Holden 1998) and in the Colorado River with U.S. Fish and Wildlife Service (Lamarra 1998, Osmundson and Scheer 1997, Osmundson 1998) have illustrated the value of quantifying these environmental factors toward better understanding trends in the abundance and condition of the species in the fish community. As the Bioenergetics-Population model is being finished, data on the trophic structure of all ecosystem components is needed. Considering the influence of the flow regime in these environmental factors and in turn their influence on the fish community it is critical to quantify the detrital, primary, and secondary biomass dynamics in order for the populations goal model to be used as a management tool and to accurately estimate the carrying capacity of the San Juan and Animas Rivers for Colorado pikeminnow.

Objectives:

1. Further refine the correlation between population and abundance of fish using the first pass of population estimate and relative abundance during monitoring surveys.

2. Obtain fish population estimates for San Juan River fish community at two reaches in the San Juan River and one reach of the lower Animas River.

3. Obtain additional field data for population model calibration and validation.

4. Obtain data on forage base in the San Juan and Animas rivers for use on carrying capacity determinations in the population model.

5. Determine the temporal changes in physical and biological conditions in selected riffle and run habitats in the San Juan and Animas Rivers in order to calibrate the bioenergetics-trophic model.

6. At the same locations, determine primary production and community respiration rates (functional parameters) as well as the rate of detritus drift. This will allow a calculation of detritus mass balance in the river system.

Methods:

Population Estimates

The specific work tasks for this proposal is an intensive electrofishing effort in two reaches of the San Juan River (Selected from Reaches 3 – 7) and one site in the lower Animas River. The methods for data collection would follow protocols established in 1998 and 1999. In each reach the following methods would be employed to develop population estimates.

Specific Habitat Estimates:

In each river reach, two riffles and to shoreline run habitats will be selected as locations for multiple pass removal location for small bodied fish population estimates. Three to five removal passes would be made in each selected habitat. The number of removal runs required will be determined by the number of fish collected each pass. The riffle habitat will be sampled over its entire width. In addition to hand held dip nets, a bag seine will be placed downstream of the electrodes to capture stunned fish. A small mesh seine will be placed parallel to the river bank during sampling of the shoreline run and a bag seine positioned at the downstream end of the blocking net. Surface area sampled and seconds electrofished will be recorded for each habitat. Quantitative periphyton and macroinvertebrate samples will be collected at each riffle and shoreline run sampling location

One mile river reaches:

A one mile reach will be selected in each of the two river reaches for population estimates. At least four removal passes will be made in each one mile reach using three electrofishing rafts. All removal passes in any one mile reach will be made on the same day. All fish captured, except Colorado pikeminnow (*Ptychochelius lucius*) and razorback sucker (*Xyruachen texanus*) will be retained in separate holding nets and processed after all passes are completed. The rare fish will be weighed measured and released at the end of the pass in which they were collected. Prior to release these fish will be checked for PIT tags.

Primary and Secondary Productivity

Because the San Juan River is influenced to a large degree by periods of summer storms and high sediment loadings as well as periods of stable clear fall/winter flows, a temporal aspect of the models will be investigated.

Study area

The study area will encompass the San Juan River from the Animas River confluence to Bluff, Utah. A total of three geomorphic reaches have been selected in this area of the river and these will form the framework for the comparison of various physical and biological factors. The river below Bluff, Utah (Reaches 1 and 2), is entirely canyon-bound. Due to logistical constraints and considering the relatively low primary and secondary productivity and paucity of fishes in the main river channel, no sampling will be undertaken in this area of the river. In addition, one site on the Animas River (near Aztec) has also been selected for this investigation.

Sampling design (Physical, Primary/Secondary Production)

Three riffle and three run habitats will be sampled in each of the four sites mentioned above for the following parameters. Sampling for all parameters (except fishes) will occur monthly for one year Fish sampling has been discussed above.

Physical	Biological
Depth	Periphyton (gm/m^2)
Water velocity	Detrital Biomass (g/m^2)
Temperature	Benthic macroinvertebrate biomass (g/m^2)
Light (taken with depth)	Detrital drift (kg/m^3/hr)
Dissolved oxygen	
Total suspended solids	
Substrate composition	
Substrate embeddedness	

Water depth (m) and mean column (0.6D) velocity (cm/sec) will be measured at the site of invertebrate collections in both riffle and run habitats. Water velocity will be measured using a Marsh-McBirney current meter, These physical variables can vary considerably throughout the river, in run habitats particularly, exerting substantial influence use by fishes. Every attempt will be made to select riffle and run habitats in each reach that are similar with respect to their physical characteristics (i.e. depth and velocity) to maintain comparability between reaches.

Temperatures (EC), dissolved oxygen (mg/L), and total suspended solids (mg/l) will be measured at the mid-stream of each habitat. Temperature and dissolved oxygen will be measured using a Hydrolab unit. A grab water sample will be taken at each site and frozen for analysis of total suspended solids (TSS) and nutrients at ERI. The amount of TSS in the water greatly determines the degree of light penetration into the water, and thus greatly affects the amount of periphyton present, a common food for grazing invertebrates and fishes. Light extinction with depth will be determined in each habitat to the 1% of surface incidence level, or to the bottom, whichever occurs first.

Substrate composition will be assessed via pebble counts (100 count) in each habitat of randomly selected substrate particles throughout each habitat. In run habitats dominated by finer substrates (< 2mm), two dredge samples will be collected and stored in zip-lock bags to be dried and sieved for particle size composition at ERI. Substrate embeddedness will be assessed by visual determination of the degree to which individual surface rocks within a given area are embedded (%) and by determination of the depth to the embedded layer (cm). Armored substrate is typically less productive (secondary, and sometimes primary production)than loose substrate of the same size. Lack of flushing glows and storm vents carrying high sediment loads are major factors in the degree to which substrate becomes armored, and thus generally less productive. In studies in the Colorado River, the percent embeddedness of substrate was found to be negatively correlated with periphytic and benthic macroinvertebrate biomass (Lamarra 1998). Prolonged, reduced benthic productivity has major implications for the fish community in the San Juan River, which is comprised nearly entirely of bottom feeders. Therefore, measurements of these physical parameters is important in understanding some of the causal mechanisms underlying temporal changes in the standing crop of various fish species.

Periphyton will be collected by harvesting a known area from the surface of the substrate at three locations of equal depth (approximately six inches) in each habitat. Each sample will be placed in a whirlpack bag,

wrapped in aluminum foil to prevent light contamination, and frozen for later analysis at ERI and subsequent determination of periphyton density (mg chl a/m5).

In addition, primary production experiments will be conducted during each hydrologic time period (upper and lower basin runoff as well as summer and winter base flow. Experiments will use *in situ* chambers to estimate primary production and respiration rates (g C /m^2/day) and their relationship to ambient light.

Benthic macroinvertebrates will be collected by Hess sampler (0.086m5 area) at three locations of each riffle and run habitat. Sampling will occur along the longitudinal gradient of the habitat, in no more than two feet of water. Substrate will be disturbed to the embedded layer in habitats dominated by coarser substrate, or to approximately two inches depth in habitats dominated by finer substrate. Samples will be preserved in glass jars with a 70% isopropanol solution. Numbers of invertebrates will be assessed by density (#/m5) and biomass (estimated by volume in ml/m5). Detritus (coarse organic matter) will be harvested from these same samples, oven-dried at 60EC, and biomass determined in mg/m5.

Schedule:

Field collection for productivity data will be on a monthly basis. Sites will be the same as those used during the 2000 field season. Field data collection for population model/ monitoring correlations will require approximately one week to complete the fish collections and associated activities. Field work is tentatively scheduled for September 2001.

Products:

A summary report of population estimates, age class structure and trophic components for each sampling location will be produced by December 2001.

(See budget on next page.)

Budget:

Miller Ecological Consultants is seeking funding from the recovery program for this effort. This funding request also will be submitted to the Southern Ute Indian Tribe for consideration. Total funding requested is shown in the following table.

Population Estimates	
Labor	$ 15,460
Travel	$ 3,392
Equipment	$ 1,410
Total	**$ 20,262**

Ecosystems Research Institute:

Ecosystems Research Institute $72,402

Funding for ERI listed in BIA budget numbers.

Funding Requested:

Funding for the ERI portion of the work is being funded by BIA. Funding for MEC has been submitted to the Southern Ute Indian Tribe as an addition to the FY2001 budget. Based on past funding requests to the Tribe it is likely that additional funding from the Recovery Program will be needed for MEC to complete the proposed work. We are requesting funding up to the total $20,262.00 from the program.

Polynuclear Aromatic Hydrocarbon (PAH) Study
Fiscal Year 2001 Project Proposal

Principal Investigator: Dale Wirth
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Background

In July of 1991, the Albuquerque District Office of the Bureau of Land Management (BLM) issued a Draft Resource Management Plan Amendment (RMP)/Environmental Impact Statement (EIS) regarding oil and gas leasing in San Juan, McKinley, Sandoval and Rio Arriba Counties. The main land mass affected by the RMP is under the management of the Farmington Field Office (FFO).

July 20, 1993, the United States Fish and Wildlife Service (USFWS) issued a Formal Section 7 Biological Opinion on the RMP/EIS. The Biological Opinion stated that "....the ongoing and proposed oil and gas leasing and development activities are likely to jeopardize the continued existence of the Colorado pikeminnow (formerly Colorado squawfish) and the razorback sucker by reducing the likelihood of both the survival and recovery of the species through degradation of the aquatic habitat in the San Juan River."

In order to define parameters for the study identified in the Reasonable and Prudent Alternative, USFWS and BLM agreed to develop a project that would investigate possible sources of PAHs due to the federal oil and gas leasing program. These sources include water and sediment from the San Juan, La Plata, and Animas Rivers, ephemeral washes, and discharge pits located on and directly associated with well locations. In addition, BLM and USFWS have agreed to work cooperatively to establish baseline air quality data that addresses possible impacts from the gas and oil production industry under the jurisdiction of the FFO.

The biological opinion that was published July 20, 1993 contained three phases for the PAH study to be conducted by the BLM. Phase I, conducted in 1994, established a baseline data set for the FFO for both streams and ephemeral washes, as well as, well locations in the vulnerable zone and in-stream semi-permeable membrane device placement to determine total cumulative exposures (performed by FWS).

Phase II of the study calls for any identifiable sources to be further investigated and remediated, and for continued monitoring throughout the basin, while Phase III calls for long term monitoring of PAHs throughout the FFO. In actuality, Phases II and III have been integrated and are considered as on-going processes.

The major problem concerning the issue of PAH contribution by oil and gas development is the lack of surface water systems data within the Basin, PAH mobility data, a lack of information regarding toxicological effects, and possible PAH contributions form other likely sources within the Basin.

Due to the lack of data concerning the distribution of PAHs, one of the main goals of Phase I was to develop a database identifying the locations of possible sources and occurrences of PAHs. In order to achieve this goal, BLM developed maps of the sample collection locations, as well as an electronic data base of all locations, sample types, and concentrations levels. This data is continually refined to include additional data, sample

location data, newly collected analytical data, and other information that may be pertinent to evaluating the PAHs found.

The goals of Phase II and III focused on the locations that demonstrated measurable levels of PAHs and to try to determine if chemical migration was occurring from the locations. River monitoring was increased to both spring and fall to determine seasonal effects of high flows associated with spring run-off and low flows associated with the cessation of irrigation return flows in the fall.

BLM's data collection activities included surface run-off and oil and gas well locations located in the focused vulnerable area because of the concern that PAHs may be discharged to the surface water system via unlined pits associated with production activities. Types of waste discharges that are collected in pits in the basin include: condensate from pipeline drip, separator discharges, dehydrator drip, and brine water collection. The State of New Mexico Oil Conservation Commission initiated regulations for pit closures in 1988. Following the Oil Conservation Commissions pit closure regulations, the BLM implemented a pit remediation program designed to clean up potential groundwater contamination sources and replace the unlined pits with lined pits and/or tanks to prevent further releases on federal leases. BLM's pit remediation program has been successful in the elimination of waste discharges into unlined pits located within and outside the focused vulnerable area.

Sampling of well locations included collecting a sample from within the pit, and another sample off-site and hydrologically downgradient. Samples were collected with an Oakfield stainless steel soil core sampler. The sampling depths varied depending on the accessibility to the pit, as well as sediment compaction. Generally, sample depths in the pits ranged from two to three feet while those collected down gradient were collected at a shallower depth of one to two feet.

Ephemeral streams were sampled throughout the basin in order to determine migration of PAHs via the ephemeral drainage system. Soil moisture was encountered from one inch to over two feet, depending on the size and location of the stream bed. Sample collection was done with an auger and core sampler similar to the well location samples. Depth for sample collection in the ephemeral streams ranged from six inches to two and one half feet.

Water and sediment samples were collected in twenty five locations throughout the San Juan River Basin. Locations were chosen based on possible drainage and contaminant loading sources such as municipal discharges, industrial discharges, large ephemeral stream drainages and known agricultural return flow locations. In 1998, sample locations were expanded from twenty five to twenty seven locations. Water samples were collected in the water column by cross sectional and vertical stratification in two liter brown glass bottles at each location. Sediment samples were collected with a Weldco Hand Core Sediment Sampler to an average depth of two to six inches.

Air monitoring was conducted at ten deployment locations in the summer of 1998. Five locations were identified in upland areas and five were identified along river tracts. Each deployment site consisted of three semi-permeable membrane devices (SPMDs): site blank, exposure to direct sunlight, and canopy or shaded cover exposure for a total of 30 SPMD's. The locations selected were developed in conjunction with the USFWS, and will provide information not only within the San Juan Basin, but will also provide information on PAHs that might be carried into the basin by prevailing winds. The air monitoring data will provide empirical data and will not provide data on air source locations.

The samples collected (air, water, and sediment) were analyzed by Quanterra Labs (now Severn Trent Laboratories, Inc, [STL]) in Denver, Colorado using EPA method 8310 for soil and water and EPA method 8270 for air. Detection limits in ug/kg and u/l were as follows:

PAH	Soils	Water
Napthalene	200	0.95
Acenapthylene	200	0.95
Acenapthene	200	0.95
Fluorene	40	0.19
Phenanthene	40	0.19
Anthracene	20	0.095
Fluoranthene	40	0.19
Pyrene	40	0.19
Benzo (a) anthracene	20	0.095
Chrysene	40	0.19
Benzo (b) fluoranthene	20	0.095
Benzo (k) fluoranthene	20	0.095
Benzo (a) pyrene	20	0.095
Dibenz (a,h) anthracene	40	0.19
Benzo (g,h,I) perylene	40	0.19
Indeno (1,2,0-cd) pyrene	40	0.19

Soil and water samples were collected and stored on ice in the field. The samples are transferred to a refrigerator at the FFO. All samples were shipped within 48 hours of collection. The samples were packed in cooler with ice and shipped to the Quanterra Lab overnight. Data reports were submitted directly to BLM along with an electronic copy.

Objective

Preliminary conclusions, based on the soil and water data collected over the past six years in the San Juan Basin suggests that the oil and gas leasing program is not imputed to be contributing PAHs to the Colorado pikeminnow and razorback sucker habitat via surface run-off. Airborne contamination study results are still pending and may affect the preliminary conclusions of the soil and water data.

The sediment and water sampling program has been relatively ineffective. Reasons for this may be attributed to the short life of PAHs which are quickly partitioned either to sediment or biota, sediment cycling and removal, the complete absence of PAHs from the San Juan or Animas Rivers, or a combination of all these factors.

Upon review of the water and sediment data, discussions and e-mail correspondences between the BLM and the USFWS Ecological Services Field Office, in Albuquerque, New Mexico were undertaken during June and July of 1999. A consensus was reached that additional monitoring of river water might not be as effective in determining major routes of PAH transport as would other methods, namely storm water collection and additional air monitoring.

Therefore, as a result of discussions and correspondence with the USFWS in 1999 the BLM will be continuing the Phase III long term monitoring for PAHs by collecting storm water runoff. Air monitoring obligations, as outlined in the Biological Opinion have been fulfilled and will not be undertaken for fiscal year (FY) 2001.

Method

Efforts will be made to obtain storm water samples for the identified drainages. However, discretion and flexibility will be exercised by BLM to substitute an alternate drainage in the immediate area in the event that identified drainage can not be sampled or fails to experience a storm water flow event. The five ephemeral tributaries include Canyon Largo, Gobernador Canyon, Shumway Canyon, contributing to the San Juan River and Ditch Canyon and Bohanon Canyon contributing to the Animas River. Water samples will be collected in two liter brown glass bottles at each location, stored on ice and shipped within 48 hours for analysis.

Products:

The annual report and electronic data files for the FY 2000 sampling program were delayed due to procurement and laboratory processing backlogs. Preparation of a FY 2000 annual report will be forth coming. Preparation of an annual report and electronic data files for upcoming FY 2001 storm water sampling program is anticipated for the spring of 2002 .

Budget:

Labor	$ 10,000
Travel	$ 2,000
Vehicle	$ 1,000
Supplies	$ 2,000
Overhead	$ 5,000
Procurement	$ 30,000
TOTAL	**$ 50,000**

IV. Recovery Efforts

Non-Native Species Monitoring and Control
Fiscal Year 2001 Workplan Proposal

Principal Investigators - Jim Brooks, Chris Hoagstrom and Barry Wiley
New Mexico Fishery Resources Office, U.S.F.W.S., Albuquerque, NM

Background:

During 1991-1997, nonnative species studies on the San Juan River focused on the identification of impacts to native fishes. Research characterized the distribution and abundance of non-native species in main channel habitats, seasonal movements of channel catfish and common carp, the food habits of non-native predators, primarily channel catfish, the overlap of resource use between native and non-native fish species, and the relation of these findings to differing flow regimes. Channel catfish were the single most abundant large non-native predator in main channel collections. Data indicated that channel catfish occupied a variety of habitats within the main channel, generally exhibited localized movement, and at lengths > 450 mm TL preyed upon native species.

Increased and focused mechanical removal efforts were employed during 1998-2000 to remove more than 7,000 channel catfish and 4,000 common carp. Analyses of 1998-1999 data illustrated the decline in the abundance of channel catfish > 300 mm TL, presumably due to removal efforts, throughout the study area. Common carp, on the other hand, did not change in distribution and abundance or size class structure. The emphasis of removal of channel catfish and common carp was placed on a portion of Reach 6 (PNM weir to Hogback Diversion) and was designed to address removal or minimization of the reproductive effort in the upper portion of the species' occupied range. Theoretically, continued removal in upstream reaches would eventually lead to decreased reproductive success and recruitment in downstream reaches where young tend to drift.

Given the popularity of channel catfish as a sport fish and the concerns expressed by the public regarding disposal of removed fish, a program to transplant removed fish to isolated fishing impoundments was initiated in 1998. Channel catfish were removed by raft-mounted electrofishing gear and transplanted by Navajo Nation and State of New Mexico hatchery trucks to closed impoundments managed for recreational fisheries. This effort was strongly supported by the Navajo Nation and the State of New Mexico and the local publics and continues to be a popular addition to local recreational fisheries, based upon newspaper reports.

Other nonnative species are also a major concern during removal efforts, particularly with recent survey results. Electrofishing surveys in the San Juan River during 2000 have identified the widespread distribution and heretofore unseen abundance levels of striped bass upstream as far as the PNM weir. The increased surface elevation of Lake Powell has continued to inundate a former barrier to upstream movement of fish and the lack of summer rainstorm-related flow events are likely reasons for the observed increase in the abundance and distribution of striped bass. This species poses a substantial threat to native San Juan River fishes through predative impacts necessitates increased removal efforts.

To date, mechanical removal efforts for nonnative fish species in the San Juan River have simply entailed removal of all individuals encountered. In a review of fish control projects, Meronek et al. (1996) evaluated the effectiveness and reasons for failure or success of a control project in accomplishing desired goals (reduction in the abundance or age class structure of target species). It was concluded that reasons for failure were generally

unknown due to the lack of explicit rationale and/or measurable objectives for target reduction levels and inadequate pre- and post-treatment data. The rationale for San Juan River efforts, although not detailed in any report, is that a reduction in the biomass of nonnative species will translate to an increase in native species biomass. The primary strategy for removal efforts is based upon consistent removal of all non-natives during all sampling efforts. This strategy is general in it's application and would likely benefit from an alternate application using the "predator"strategy (Vokoun and Rabeni 1999). In the "predator" strategy, the sampling gear with the least energy expenditure is selected and applied to the locations where the greatest catch rate will be accomplished. In the San Juan River, this would apply to the use of electrofishing gear during low-flow conditions and emphasize macrohabitats known to concentrate target nonnative species. Despite the general application of removal efforts, the abundance of channel catfish > 300 mm TL has declined and resulted in an overall reduction in length frequency distribution (Brooks et al. 2000; Ryden 2000 a,b; Smith and Brooks 2000), but recent sampling efforts have also identified an apparent increase in the abundance of smaller size classes. Alternatively, common carp abundance and length frequency do not appear to have been altered by removal efforts. In addition to the collection of data for identification of the processes that regulate the abundance and distribution of nonnative species, development of specific, measurable removal objectives are needed.

There are aspects of age and growth and size and fecundity of sexually mature channel catfish (Helms 1975; Hubert 1999 a,b; Jearld and Brown 1971; Raibley and Jahn 1991) that can be used in development of a target maximum length frequency in suppression efforts. Pitlo (1997) estimated that increasing the abundance of adult channel catfish from > 330 to > 380 mm TL would increase the reproductive potential ten-fold. Tyus and Nikirk (1990) determined age and growth patterns for channel catfish in the Green River, Utah, but did not report on age or size at sexual maturity. Our preliminary data (Smith and Brooks 2000) indicate faster growth rates than those from the Green River, but Hubert (1999a,b) did not report any consistent trends in growth rate throughout North America in both lotic and lentic environments. Preliminarily it appears that a target length frequency which minimizes channel catfish > 330 mm TL should be employed. Determination of specific age and growth patterns and size at sexual maturity would allow for refinement of this target length frequency, including identification of a target mean length and acceptable standard deviation from the mean. Accomplishment of the target in the sub-reach Reach 6 (PNM Weir to Hogback), for example, would allow intensive removal efforts to be transferred downstream to the next sub-reach, i.e. Hogback to Shiprock. Concurrently, suppression efforts would continue throughout the San Juan River during routine sampling and elevated, but less intensive removal would continue upstream of the current intensive removal sub-reach to maintain the target length frequency.

This workplan proposes to continue mechanical removal of channel catfish and other non-native species in conjunction with main channel adult monitoring and rare fish stocking efforts. Monitoring data on the distribution, abundance, and food habits of non-native species will be collected and analyzed. Additional emphasis will be placed upon efforts to remove striped bass and to characterize distribution and abundance patterns. The size at sexually maturity for channel catfish in the San Juan River will be evaluated by examination of reproductive organs from all size classes encountered. Finally, removal and transplantation of San Juan River channel catfish to isolated impoundments currently used for recreational fisheries will be continued and expanded to recreational fishing waters under the jurisdiction of the State of New Mexico.

Objectives:

1. Continue data collection and mechanical removal of non-native species during main channel adult rare fish monitoring efforts.

2. Evaluate distribution and abundance patterns of non-native species to determine effects of mechanical removal on abundance and distribution patterns.

3. Continue and expand program for mechanical removal and transplantation of channel catfish.

4. Characterize the distribution and abundance of striped bass into the San Juan River upstream of Lake Powell during removal efforts and determine predative impacts via stomach content analysis.

5. Relate size of channel catfish to sexual maturity for use in development of a specific target objective for removal efforts.

Methods:

Mechanical removal will continue during the fall main channel monitoring efforts. During these sampling efforts, all nonnative species collected will be sacrificed and data recorded for species identification and enumeration, ontogenetic stage (young-of-year, sub-adult, adult) at non-designated miles, and standard and total lengths and weight at designated miles. Data will be summarized by geomorphic reach and sampling will occur two out of every three river miles. Tagging data for recaptured channel catfish and common carp tagged during 1993-1996 will be recorded in the field and integrated into existing databases for movement and abundance. Catch per unit effort (CPUE) will be calculated as number of fish collected per minute electrofishing time and be calculated for the total collection and for each species. Analyses will include comparison to 1991-2000 data summaries.

Separate, three day efforts for mechanical removal in the San Juan River reach between PNM Weir and Hogback will occur biweekly during February, March, April, and early May, prior to spring high flow. Monthly removal efforts will be employed during June, July, August, September and December. Sampling will be by two electrofishing rafts and captured channel catfish will be measured (nearest 1 mm) for standard and total lengths, weighed (nearest 1 g), and, if not sacrificed for study purposes, transported by hatchery truck to isolated recreational angling impoundments in the Four Corners region. All other nonnative species sampled during these efforts will be sacrificed and appropriate data recorded for location, length/weight, and, for lacustrine predators, stomach contents. Total and individual daily CPUE will be calculated to evaluate efforts of short-term suppression efforts to locally deplete nonnative species numbers.

A minimum sample of 500 channel catfish will be analyzed for development status of reproductive organs. Specimen standard and total lengths (nearest 1 mm), weight (nearest g), sex, method of capture, location (RM), and date will be recorded. The suggestions of Lagler (1956) will be followed for determination of the maturity and state of sexual organs. Sexual organs will be classified as immature (no eggs or milt evident), ripe (eggs and milt grossly evident), or spent (ovaries or testes involute) for the suspected spawning season (April - August) and as immature (no eggs or milt evident) and mature (eggs or milt apparent) the remainder of the year. The length frequency for specimens with mature reproductive organs will be determined to characterize the relationship between size and sexual maturity.

Striped bass control efforts will be combined with other mechanical removal efforts unless high abundance and distribution patterns observed in Fiscal Year 2000 are encountered during spring/summer 2001. If it is determined that abundance and distribution are high, based upon spring sampling for both mechanical removal efforts and razorback sucker monitoring, specific removal efforts will be employed between Farmington, New Mexico and Bluff, Utah. Two sampling efforts during July and August after cessation of high flows will be

employed, using three electrofishing rafts. All nonnative fishes will be removed. Lacustrine non-native species (primarily striped bass, walleye, largemouth bass) collected in the San Juan River will be sacrificed for stomach content analysis and determination of gender and reproductive status. Stomachs will be removed from each specimen captured and preserved in 10% formalin for lab analyses. Data recorded for each specimen are date, location (RM segment), species, standard and total lengths (nearest 1 mm), weight (nearest 1 g), and sex. Stomach content analyses will identify frequency of occurrence and weight by individual prey species, stomach fullness and relate standard length of identifiable prey species to predator standard length.

Deliverables:

Participation will continue in data integration efforts to incorporate 1998-2000 data, produce an annual report, refine flow recommendations as appropriate, and complete revision of SJRRIP planning documents . An electronic data file will be provided for inclusion in the centralized database by 31 March 2002. An annual report detailing findings will be completed in draft by 31 March 2002 for SJRIP Biology Committee review and finalized by 1 June 2001.

(See budget on next page.)

Budget[1]**:**

Personnel:		
Nonnative species removal/channel catfish translocation	$	64,300
Laboratory processing of samples	$	3,500
Reporting/data management	$	12,600
Subtotal	$	80,400
Travel/per diem:		
Removal/translocation	$	11,250
Reporting/data management	$	750
Subtotal	$	12,000
Equipment and supplies		
Removal/translocation	$	4,500
Miscellaneous	$	800
	$	
Subtotal	$	5,300
TOTAL	$	97,700
Administrative Overhead (20%)	$	19,540
GRAND TOTAL	**$**	**117,240**

[1] Includes in-kind assistance from New Mexico Department of Game and Fish for PNM Weir to Hogback reach. Increased sampling frequency and additional downstream reach sampling, will require additional personnel, equipment, and travel costs for New Mexico Department of Game and Fish, Utah Division of Wildlife Resources, and U.S. Fish and Wildlife Service (Grand Junction).

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Razorback Sucker Augmentation
Fiscal Year 2001 Project Proposal

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Background:

Razorback sucker are native to the San Juan River. At present this species is extremely rare in the San Juan. In order to gain information on habitat use, possible spawning areas, and survival and growth rates of hatchery-reared razorback sucker in the wild, it was necessary to experimentally stock a small number of fish. Experimental stocking of razorback sucker into the San Juan River began in 1994, as was outlined in An Experimental Stocking Plan For Razorback Sucker In The San Juan River. Between 1994 and 1996, a total of 939 razorback sucker were stocked into the San Juan River by personnel from the U.S. Fish and Wildlife Service's (Service) Colorado River Fishery Project (CRFP) office in Grand Junction, Colorado. All 939 were progeny of paired matings between San Juan River arm of Lake Powell adults. All fish were PIT-tagged before release into the wild. In March 1994, 15 razorback sucker were divided and stocked in equal numbers at river mile (RM) 136.6, 117.5, and 79.6. Between 27 October and 18 November 1994 and additional 671 razorback sucker were stocked in roughly equal numbers at these same three stocking sites and at Hogback Diversion (RM 158.6). On 27 September 1995, 16 razorback sucker were stocked at Hogback Diversion. The last stocking associated with this study occurred on 3 October 1996, when 237 razorback sucker were stocked at Hogback Diversion. Based on the success of this experimental stocking study the decision was made to implement a full-scale augmentation program for razorback sucker in the San Juan River. Information obtained during the evaluation of stocked razorback sucker will help address objectives 5.1 through 5.5 in the San Juan River Long Range Plan.

In August 1997, a Five-Year Augmentation Plan for Razorback Sucker in the San Juan River was finalized. The five-year augmentation plan, recommended the stocking of 31,800 razorback sucker into the San Juan River during Year 1. Stocking of razorback sucker from various sources into the San Juan River began in early September 1997. However, between 3 September 1997 and 15 October 1998 a total of only 4,164 razorback sucker were stocked into the San Juan River (Table 1).

The inability to achieve San Juan River razorback sucker augmentation goals has been due to a suite of circumstances all of which ultimately result in a lack of fish. Rearing facilities outside of the San Juan River Basin lack the capabilities to continue to hold and rear razorback sucker for the San Juan River Recovery Implementation Program (SJRIP). Given this lack of resources, efforts were undertaken to develop and establish rearing facilities (holding ponds) within this basin thereby affording self-sufficiency to the San Juan River razorback sucker augmentation program.

Table 1. A summary of razorback sucker stocked into the San Juan River as part of the five-year augmentation plan. All stocked fish were PIT-tagged before being released into the wild.

DATE	NUMBER	SIZE	RELEASE LOCATION	PARENTAL STOCK
3 SEP 1997	1,027	JUVENILE	Hogback Diversion	Lake Mohave
17 SEP 1997	227	JUVENILE	Hogback Diversion	Green River X Yampa River
19 SEP 1997	1,631	JUVENILE	Hogback Diversion	Colorado River or Colorado River Arm of Lake Powell X Etter Pond
22 APR 1998 & 28 May 1998	124	JUVENILE	Hogback Diversion	Green River
14-15 OCT 1998	1,155	JUVENILE	Hogback Diversion	Lake Mohave
TOTAL	4,164			

Razorback sucker intended to be stocked in 1999 were being reared in Ojo Pond. However, on 3 August 1999, heavy rains caused the dam at the Ojo Pond to wash out, draining the entire pond. Subsequent recovery efforts by personnel from the Bureau of Indian Affairs Navajo Indian Irrigation Project (BIA-NIIP) office in Farmington, New Mexico recovered approximately 180 razorback sucker in Ojo Wash. These fish were placed into another holding pond, East Avocet Pond. However, the majority of fish that were to be stocked in the San Juan River in 1999 were not recovered. Due to the loss of Ojo Pond, no razorback sucker were stocked in 1999. Thus, since 1994, a total of 5,103 razorback sucker have been stocked into the San Juan River (4,164 since the five-year augmentation effort for this species was begun in 1997). This represents a shortfall of 51,168 fish when compared to numbers recommended in the five-year augmentation plan.

The number of excess razorback sucker currently available to the SJRIP from Upper Colorado River Basin (UCRB) recovery efforts will not be sufficient to make up current shortfalls and achieve the goals prescribed in the five-year augmentation plan. One approach to making up shortfalls is to obtain razorback sucker larvae from Lake Mohave. These larvae can be collected from the lake from February through April. Additional larvae can be produced at Willow Beach National Fish Hatchery by spawning wild Lake Mohave adults. Since the majority of these larvae are produced in March, they will need to be temporarily retained until food availability and water temperatures are adequate in the holding ponds to support them (usually mid- to late-May).

We propose to address this concern by establishing temporary holding facilities for larval razorback sucker collected in Lake Mohave. Such a facility will serve to maintain larvae in the interim (8-10 weeks) between

their capture at Lake Mohave and a time when water temperatures at holding ponds (Avocet Ponds and the newly-constructed Hidden Pond) increases to a level sufficient for rearing of larvae.

Personnel from the Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico (UNM), have been involved in short-term rearing of larval fish for five years. Over 50,000 larval cyprinids, represented by five Pecos River species, were reared during 1996 and 1997. Most recently (May-June 2000), Division personnel spawned, reared, and released over 200,000 larval Rio Grande silvery minnow. The same rearing system was used during both studies and has proven sufficient to hold large numbers of individuals and flexible enough to accommodate a range of environmental requirements.

Description of Study Area:

Larval razorback sucker obtained from Lake Mohave in the Lower Colorado River Basin (LCRB) in spring 2001 will be transported to interim rearing facilities at the University of New Mexico. The rearing facility will be constructed to hold and rear up to 50,000 larval razorback sucker for a period of between 6-10 weeks. Water temperature information acquired from holding ponds (Ojo and Avocet) during previous years, suggest that by May, water temperatures will have achieved a sufficient level to sustain larval razorback sucker. These data indicate that the interim holding facilities should be prepared to accommodate larvae for at least 6 and up to 10 weeks. The goal will not be to hold larval fish in the interim facility for a pre-determined time period but instead to establish them in Hidden and Avocet ponds, near Farmington New Mexico, as soon as conditions allow.

Razorback sucker will be reared at Hidden and Avocet ponds until fall 2001, when they will be harvested, PIT-tagged and stocked into the San Juan River just downstream of the Hogback Diversion (RM 158.6), between Farmington and Shiprock, New Mexico.

The study area for the monitoring of razorback sucker stocked into the San Juan River extends from RM 158.6 downstream to RM 76.4 (Sand Island boat landing) near Bluff, Utah.

Objectives:

1. Acquisition of larval razorback sucker from Lake Mohave (and possibly UCRB) and transfer to MSB (performed by MSB, CRFP, BIA-NIIP personnel)

2. short-term rearing of up to 50,000 larval razorback sucker taken from Lake Mohave (MSB)

3. Transfer reared larval razorback sucker from MSB to Hidden and Avocet ponds (CRFP)

4. Maintenance of holding ponds (BIA-NIIP)

5. Assess success of interim rearing effort and determine the feasibility of this pilot project and report findings in an interim progress report (MSB)

6. Harvest razorback sucker from ponds, PIT tag, and stock fish downstream of Hogback Diversion (CRFP, BIA-NIIP)

7. Monitor spawning season habitat use and movement patterns of hatchery-reared razorback sucker in the wild (CRFP)

8. Monitor survival rates and growth rates of hatchery-reared, known-age razorback sucker in the wild (CRFP)

9. Determine whether hatchery-reared razorback sucker will recruit into the adult population and successfully spawn in the wild (CRFP, MSB)

10. Produce an interim progress report for results and findings of razorback sucker monitoring field work (CRFP)

Methods:

CRFP personnel will coordinate the collection of larval razorback sucker from Lake Mohave during March and April 2001. Larval fish will be obtained from various sources, including wild larvae collected directly from Lake Mohave and from spawning of wild Lake Mohave adults performed at Willow Beach National Fish Hatchery. MSB personnel will assist in those sampling efforts. Larval razorback sucker from Lake Mohave will be transferred to the interim rearing facility at MSB with handling and transport following existing U. S. Fish and Wildlife Service protocols. Growth and survival will be tracked during the rearing tenure at MSB. CRFP personnel will determine when it is appropriate to transfer larval razorback sucker from the interim MSB holding facilities to Hidden and Avocet ponds (presumably May to June). This transfer and disposition of larvae will be determined and coordinated by CRFP personnel with the assistance of MSB personnel.

Larval razorback sucker will be reared at Hidden and Avocet ponds throughout the summer and early fall of 2001. Maintenance of water level and monitoring of pond water quality will be performed by BIA-NIIP personnel. Additional razorback sucker larvae may also become available as excess fish are culled from lots being produced for augmentation efforts in the UCRB. If this is the case CRFP personnel will transport these fish to the appropriate holding pond. In fall 2001, razorback sucker will be harvested using fyke nets, trammel nets, or other appropriate gear, PIT-tagged, and stocked into the San Juan River downstream of Hogback Diversion (RM 158.6).

Stocked fish will be monitored on two electrofishing/netting trips in 2001. Both trips will sample from RM 158.6-76.4. The spring sampling trip will occur before runoff begins, in late March or early April. The summer trip will occur after the hydrograph has returned to summer baseflow. Electrofishing, seining, and trammel netting will be used to determine dispersal, and survival of stocked fish. The fall 2001 main channel fish community monitoring (i.e., long-term monitoring) trip will act as a third trip to monitor stocked razorback sucker throughout the year. Survival rates will be determined using either mark-recapture models (Program CAPTURE, MARK, etc.) or age/growth curves or a combination of the two. Electrofishing and handling of rare fish species will follow the protocol found in the main channel fish community monitoring workplan, except that electrofishing will be done every mile, instead of 2 out of every 3 miles and only data on rare fish species collected (i.e., razorback sucker, Colorado pikeminnow, and roundtail chub) will be recorded. When rare fish species are collected, PIT tag number, length, weight, reproductive status (if evident), and information about health abnormalities (if any) will be recorded.

In support of Objectives 7 and 9, up to eight razorback sucker will be implanted with radio transmitters (one-year lifespan) on the fall 2000 main channel fish community monitoring trip. These fish will be tracked throughout the suspected spawning season for razorback sucker in the San Juan River (i.e., late February though early June). Tracking trips will be conducted on a monthly basis (minimum of four trips) from the last week of February to the first week of June. If spawning aggregations of razorback sucker are identified, trips will be done on a weekly basis, concentrating on the spawning fish. Fish contacted during radio tracking trips will be

tracked for a minimum of one hour each. At the end of the contact, all riverine habitats for 100 meters both up- and downstream of the most up- and downstream fish locations during the contact period will be mapped on hard copies of aerial videography. All habitats utilized by the fish will be recorded as well as the amount of time spent in each particular habitat type. Once back from the field, relative percentages of habitats available and habitats used will be determined, so that habitat selection can be determined as in previous razorback sucker telemetry studies on the San Juan River. During radiotelemetry contacts, detailed habitat information on substrate, depth, cover, and velocity at the fish's most frequented location will also be recorded. Water quality parameters including dissolved oxygen, water temperature, conductivity, and pH will be measured at each contact location. At the end of a radio telemetry contact, attempts will be made to recapture radiotelemetered fish via trammel netting and/or seining. Recapture efforts will be aimed at gaining data on age, growth, and sexual status as well as trying to recapture any other razorback sucker that might be aggregating with radiotelemetered fish. If spawning aggregations of razorback sucker are identified, crews from other research elements monitoring razorback sucker larval drift (i.e., Steven Platania) and habitat quality and quantity (i.e., Ron Bliesner and Vince Lamarra) will be notified.

Mechanical removal of nonnative fish species will continue to take place on all razorback sucker monitoring trips.

The Service (CRFP) will have the lead for the razorback sucker monitoring with the New Mexico Department of Game and Fish providing field personnel and equipment for monitoring trips. Other cooperating agencies will provide personnel and equipment for these trips as needed.

Products:

An interim progress report assessing the success of the 2001 razorback sucker interim holding facilities pilot program will be completed by 31 March 2002. That report will include information on both the Lake Mohave larval razorback sucker collecting effort and interim holding facility success. A "draft final" incorporating all comments received will be completed by 1 June 2002. An electronic spreadsheet containing information from the project will also be submitted to Keller-Bliesner Engineering for inclusion on the SJRIP integrated database CD-ROM by 31March 2002. Voucher series of fish collected from this study will be curated in the Division of Fishes, Museum of Southwestern Biology, Department of Biology, at the University of New Mexico.

An interim progress report for razorback sucker monitoring trips conducted in 2001 will be completed by 31 March 2002. A "draft final" incorporating all comments received will be completed by 1 June 2002. DBASE IV files containing information on total catch and length/weight data gathered for rare fish species will be submitted to Keller-Bliesner Engineering for inclusion on the SJRIP integrated database CD-ROM by 31March 2002.

Budget:

Personnel	
Laboratory Research Technician (70 man-days)	$ 5,000
GS-11 Fishery Biologist	$16,000
GM-14 Supervisor	$ 8,000
GS-7 Administrative Support	$ 2,000
Travel and Per Diem	
Travel and per diem	$ 6,000
Data Analysis and Reporting	$ 5,000
Equipment and Supplies	
Field equipment (boats, motors, radio receivers, etc.)	$ 4,000
Rearing facility equipment	$ 3,000
Larval fish food	$ 1,500
Miscellaneous supplies	$ 500
Line item subtotal	$51,000
By agency distribution of funds	
Funding for CRFP	$ 39,000
Overhead (20%)	$ 7,800
CRFP Subtotal	$ 46,800
Funding for MSB	$ 12,000
Overhead (15%)	$ 1,800
MSB Subtotal	$ 13,800
Funding for field assistance from NMDGF	$ 2,000
GRAND TOTAL	**$ 62,600**

Development of an Augmentation Plan for Colorado Pikeminnow in the San Juan River
Fiscal Year 2001 Project Proposal

Principal Investigator: Dale Ryden and Frank Pfeifer
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Background:

Colorado pikeminnow is a federally-listed endangered fish native to the San Juan River. The capture of low numbers of Colorado pikeminnow of all life stages over the past ten years has confirmed that a small, but reproducing population of Colorado pikeminnow still exists in the San Juan. In 1996, experimental stocking of Colorado pikeminnow into the San Juan River was undertaken by the Utah Division of Wildlife Resources. The purpose of this effort was to evaluate dispersal and retention of stocked juvenile Colorado pikeminnow as well as determining the availability, use, and selection of habitats critical to early life stage Colorado pikeminnow. Between 1996 and 1999, approximately 360,000 larval and age-0 Colorado pikeminnow were stocked into the San Juan River. To date, several hundred experimentally stocked fish have been recaptured during either seining or electrofishing efforts. Based on data collected from these experimentally stocked fish, it is apparent that stocked, hatchery-reared, juvenile Colorado pikeminnow can survive in the San Juan River and can provide a viable method of supplementing the numbers and expanding the range of the wild San Juan River Colorado pikeminnow population.

The need for artificial propagation and augmentation of this species in the San Juan River is apparent for several reasons. Augmentation of Colorado pikeminnow would increase population numbers, provide more individuals for research purposes, add genetic diversity to the existing gene pool, and provide a riverine refugia population that would, hopefully, remain stable until further research can identify factors limiting successful recruitment of these species in the San Juan River. The San Juan River Long Range Plan identifies the need to assess the feasibility of, and then implement the augmentation of Colorado pikeminnow. Development of an augmentation plan for this species in the San Juan River will provide the necessary guidance for augmentation efforts as well as directly fulfilling objective 5.3.8.2 of the San Juan River Long Range Plan.

Objectives:

1. Develop a 5-year augmentation plan for Colorado pikeminnow in the San Juan River

2. Spawn and rear Colorado pikeminnow at Dexter National Fish Hatchery (NFH) to be stocked in the fall of 2001

3. If possible, obtain adult Colorado pikeminnow from Dexter NFH broodstock (1991 year-class) to be stocked into the San Juan River near Farmington, New Mexico, for the purpose of studying habitat use and retention in this section of the river

Methods:

Objective 1: Based on research performed over the last six years in the San Juan River and available genetic information from both the San Juan River and the rest of the Upper Colorado River Basin, an augmentation plan will be developed for Colorado pikeminnow. The plan will include specifics on origin of stocked fish, time of release, the number of fish to be stocked, size of fish to be stocked, stocking locations, and recommendations for follow-up monitoring.

Objective 2: Colorado pikeminnow broodstock being held at Dexter National Fish Hatchery will be spawned in the spring of 2001 and the progeny will be reared for stocking in the fall of 2001. The locations of these stockings and the numbers of fish to be stocked will be specified in the augmentation plan. Protocols and objectives for the monitoring of stocked early life stage Colorado pikeminnow will be specified in a FY-2002 workplan.

Objective 3: If possible, approximately 200 adult Colorado pikeminnow (1991 year-class) will be obtained from Dexter NFH broodstock and stocked into the San Juan River near the Animas River confluence in fall 2001. Up to ten of these adult Colorado pikeminnow will be surgically implanted with 300-400 day lifespan radio transmitters and monitored to determine dispersal, habitat use and selection, and spawning habits (if apparent). Protocols and objectives for the monitoring of stocked adult Colorado pikeminnow will be specified in a FY-2002 workplan.

Products:

A draft of the augmentation plan for Colorado pikeminnow will be submitted to the Biology Committee for review and refinement by May 2001. This plan will be finalized by 31 July 2001.

Budget:

Personnel Costs

1 GS-11 Fishery Biologist	$11,000
1 GS- 7 Administrative Support	$ 1,500
Equipment and Supplies	
Radio Tags	$ 2,000
Subtotal	$14,500
Service Administrative Overhead (20.00%)	$ 2,900
GRAND TOTAL	**$17,400**

Genetics Management Plan
Fiscal Year 2001 Workplan Proposal

Principal Investigators - Larry Crist - U.S. Bureau of Reclamation,
Dale Ryden, Frank Pfeifer - USFWS, Grand Junction, CO.

Background:

The San Juan River Basin Recovery Program (SJRIP) developed a draft Genetics Management Plan in July 1997. This document was based on existing program documents developed by the Recovery Implementation Program for Endangered Fishes in the Upper Colorado River Basin (UCRIP) as well as other current literature on Genetics Management. The draft Genetics Management Plan for the San Juan River endangered fishes was reviewed by the Biology Committee but never finalized. Finalization was delayed pending completion of reports concerning genetics of the Colorado pikeminnow and razorback sucker that were funded by the UCRIP. The report, Biochemical Genetics of Endangered Colorado Pikeminnow for the Green, Yampa, Colorado and San Juan Rivers (Holt et. al 1998) has been finalized though other reports including Buth's (1994) report on Allozyme divergence among populations of razorback sucker remain in draft form and are not likely to be finalized in the foreseeable future.

As a result of the need to move forward with augmentation plans for the razorback sucker and Colorado pikeminnow the SJRIP requested that a scope of work to update and finalize the existing draft Genetics Management Plan for the San Juan River be prepared. This scope of work provides a budget and method of approach for finalizing a Genetics Management Plan. It should be noted that no previous program funds have been directed towards development of the Genetics Management Plan. Work to date has been completed using Reclamation staff and resources.

Objectives:

1. Develop a revised draft Genetics Management Plan for review by the biology committee

2. Produce final Genetics Management Plan

Methods:

The draft Genetics Management Plan developed in 1997 will be revised based on Biology Committee comments received at the time. It will also incorporate results of Holt et al. (1998) Biochemical Genetics of Endangered Pikeminnow from the Green, Yampa, Colorado and San Juan Rivers as well as other recently published literature in conservation biology and genetics as appropriate. The final Genetics Management Plan will developed consistent with the razorback augmentation plan that was initiated under the draft guidelines and the proposed Colorado pikeminnow augmentation plan that is to be developed.

Deliverables/Schedule:

Revised Draft Genetics Management Plan to Biology by March 31, 2001

Final Genetics Management Plan by June 30, 2001

Budget:

Personnel:

Preparation revised draft and final GMP		
VII. Reclamation[1]	$	4,880
VIII. USFWS	$	1,600
IX. USFWS (20% OH)[2]	$	320
Subtotal	$	6,800

Travel/per diem:

X. Reclamation[3]	$	0
XI. USFWS (1 additional meeting)	$	750
XII. USFWS (20% OH)	$	150
Subtotal	$	900

Equipment and supplies

XIII. Reclamation	$	100
XIV. USFWS	$	100
XV. USFWS (20% OH)	$	20
Subtotal	$	220

T0TAL		
XVI. Reclamation	$	4,980
XVII. USFWS	$	2,940
GRAND TOTAL	**$**	**7,920**

[1]10 staff days for senior biologist

[2]USFWS OH cost for Reclamation-USFWS fund transfers

[3]Travel costs to meetings covered under Reclamation program management

Literature Cited:

Buth, D. G. 1994. Allozyme divergence among populations of the razorback sucker, Xyrauchen texanus (catostomidae). Working draft of final report to U.S. Bureau of Reclamation. Cooperative Agreement # 0-FC-40-0960

Crist, L. 1997. Draft genetics management plan for San Juan River endangered fishes. San Juan River Basin Recovery Implementation Program

Williamson, J.H., D.C. Morizot, and G.J. Carmichael. 1998. Biochemical genetics of endangered Colorado pikeminnow from the Green, Yampa, Colorado, and San Juan Rivers. Recovery Implementation Program for Endangered Fishes in the Upper Colorado River Basin, Project FY93 #23.

Experimental Culture and Augmentation of Roundtail Chub, *Gila Robusta*, in San Juan River Colorado and New Mexico

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Background:

Roundtail chub, *Gila robusta*, historically occupied warmwater reaches of much of the Colorado River drainage (Minckley 1973, Tyus et al. 1982). In the lower Colorado River basin (downstream of Lee's Ferry, Arizona), the species has declined dramatically in the past 100 years and now persists mainly as scattered remnant populations (Minckley 1973, Bestgen and Propst 1989, Rinne and Minckley 1991). Roundtail chub continues to persist, and is comparatively common, in much of its native range in the upper Colorado River basin (Tyus et al. 1982, Bestgen 2000). However, in several upper basin streams, including Green and San Juan river drainages, roundtail chub is currently uncommon (Platania 1990, Miller and Rees 2000, Ryden and Pfeifer 2000, Bestgen 2000).

Although thorough icthyofaunal inventories of the San Juan River drainage were not conducted until the 1980s and 1990s, prior sampling documented the occurrence of roundtail chub throughout warmwater reaches of the system. These efforts documented the species in San Juan, Animas, La Plata, and Mancos rivers (Platania 1990, Miller and Rees 2000). Following closure of Navajo Dam in 1962, roundtail chub was common for several years in Navajo Reservoir (Olson and McNall 1965).

Since the late-1980s, monitoring activities on the San Juan River downstream of Animas and San Juan rivers confluence have documented rarity of roundtail chub in mainstem habitats (Ryden and Pfeifer 2000, Propst and Hobbes 2000). Tributary sampling documented persistence of the species in Mancos and La Plata rivers (Miller and Rees 2000). In the Mancos River, the species is comparatively common and persists in a short reach of La Plata River (Miller and Rees 2000). In the Animas River, several individuals were collected in 1999; these fish likely originated from the Florida River (W.J. Miller, pers. comm.). Upstream of Navajo Reservoir, roundtail chub was uncommon, but generally distributed from near Pagosa Junction downstream to the reservoir (CDOW and NMGF, unpubl. data).

Most roundtail chub specimens collected in mainstem San Juan River since the early 1990s were less than 200 mm total length (TL). Many of these fish were collected in a 30 km reach downstream of the Mancos River confluence (Ryden and Pfeifer 2000), suggesting they derived from this tributary.

Causes of the near-extirpation of roundtail chub from the mainstem San Juan River and several tributaries are related to past resource management practices. Prior to closure of Navajo Dam, rotenone was applied to the San Juan River to remove nongame native fishes in the belief that such was necessary to establish nonnative sport fisheries in the reservoir and its tailwaters. This effort killed fish as far downstream as Kirkland (about 100 km). Hypolimnetic releases from Navajo Reservoir subsequently made the San Juan River thermally unsuitable for roundtail chub downstream to at least Blanco. Widespread introduction and establishment of nonnative sport fishes, particularly channel catfish (*Ictalurus punctatus*), was likely a major factor in decline of roundtail chub. Modification of flow regimes by reservoir operations, dewatering stream segments, contaminants from mineral extraction, and urban and agricultural runoff may have contributed to near loss of roundtail chub from several tributaries (e.g., Animas River) and mainstem San Juan River.

Habitat loss may have contributed to elimination of roundtail chub from some reaches of the San Juan River, but not others. Pools associated with uprooted trees, undercut banks, and large boulders provide habitat for roundtail chub. These habitats are typically in close proximity or adjacent to moderate-to-rapid velocity water. In the river reach between Bloomfield and Farmington, the river is generally constrained to a single channel (via human manipulation) and large woody debris and boulders that contribute to pool formation is scarce. However, downstream of Shiprock, debris and boulder-formed pool habitats are common, but roundtail chub is rare.

Insufficient numbers of roundtail chub from Mancos River, or other tributaries, enter the mainstem to maintain a viable riverine population. Mainstem reproduction by roundtail chub appears nonexistent or nearly so (Platania 2000).

Within the San Juan River drainage, the proximate cause or causes of roundtail chub elimination or rarity probably vary among streams and reaches of the mainstem San Juan River. For example, in the mainstem San Juan River downstream of the PNM Weir, channel catfish are common (Brooks and Smith 2000, Ryden and Pfeifer 2000) and likely a primary reason for the near elimination of roundtail chub from this reach. Channel catfish > 300 mm TL are piscivorous. Downstream of the PNM Weir roundtail chub are rare (Ryden and Pfeifer 2000, Propst and Hobbes 2000). In contrast, roundtail chub is common in the Gunnison River, upstream of Redlands Diversion (Burdick, 1995) and channel catfish is incidental (F.K. Pfeifer, pers. comm.).

Since 1997, removal of nonnative channel catfish (and other nonnatives including common carp, *Cyprinus carpio*, and striped bass, *Morone chrysops*) from the mainstem San Juan River downstream of Farmington has been an active management tool used to enhance survival prospects for Colorado pikeminnow (*Ptychocheilus lucius*) and razorback sucker (*Xyrauchen texanus*). Although nonnative fish removal efforts have had little apparent effect on common carp abundance or its population size-structure, these efforts have had a measurable impact on channel catfish. Channel catfish >300 mm TL have decreased substantially in abundance (Brooks and Smith 2000). Continued removal of nonnative fishes is anticipated to further depress abundance of channel catfish.

Ongoing management activities to benefit Colorado pikeminnow and razorback sucker should improve conditions for restoration of roundtail chub in the San Juan River. However, abundance of the species in the

river and tributaries is apparently too low to enable a positive response to improved environmental conditions (e.g., natural flow regime mimicry and nonnative fish removal). Herein, we propose to develop an experimental culture and augmentation program for roundtail chub in the San Juan River. Specifically, the goals of this study are to:

1. Draft an augmentation plan for roundtail chub in San Juan River
2. Acquire wild fish from populations in San Juan River basin for development of hatchery brood stock.
3. Develop culture techniques for artificial propagation of San Juan River stocks of roundtail chub.
4. Stock artificially reared roundtail chub in San Juan River and evaluate/estimate survival.

Methods:

The first phase of the proposed study is to capture wild fish from extant populations in the San Juan River basin for propagation in hatchery facilities. Wild roundtail chubs are available from the Mancos, La Plata, and San Juan (upstream of Navajo Reservoir) rivers. During autumn and winter 2000, roundtail chub will be captured (30 to 50 individuals) from San Juan River upstream of Navajo Reservoir and maintained at CDOW Mumma State Fish Hatchery. These fish will enable hatchery staff opportunity to determine appropriate diet and rearing techniques. During late-winter and early-spring 2001 at least 60 individuals from each source will be obtained, with a desired sex ratio of 1:1. To maximize probability of accurately sexing individuals, collections will occur in early to mid-spring, prior to spawning but after development of secondary sexual characteristics. Collection methods will depend upon habitat, but will include electrofishing, trammel nets, and seines. Retained individuals will be measured (total and standard lengths) and mass determined. Each retained chub will receive a uniquely alphanumerically coded PIT tag. Fish will be transported in oxygenated tanks (water tempered to ambient water temperature), treated with appropriate amounts of sodium chloride, MS 222, and Stresscoat, to CDOW Mumma State Fish Hatchery. Capture and retention of roundtail chub from each source will be dependent upon obtaining permits from appropriate entities.

Published information on rearing techniques for roundtail chub is limited (although information on rearing other *Gila* spp. is available from personnel at several state and federal hatcheries) and it is therefore anticipated that some experimentation will be necessary to develop appropriate husbandry. All data relevant to sustenance of roundtail chub in hatchery environment, propagation, and maturation rates will be recorded by hatchery personnel.

Hatchery staff will attempt to develop an optimal diet for maintaining wild fish. Initially roundtail chubs likely will be maintained on a mixture of natural and artificial foods at hatchery and gradually shifted completely to artificial foods. Both sexes will be periodically checked to determine reproductive readiness. If necessary, females will be injected with carp pituitary extract to induce ovulation. Eggs of each female will be fertilized with sperm from at least two males from the same source (Mancos, La Plata, or San Juan). Offspring of each female will be maintained separately. Roundtail chubs will be maintained in hatchery until at least 150 mm TL.

Upon attaining 150 to 200 mm TL, all hatchery propagated roundtail chub will be implanted with uniquely numbered PIT tags. A portion of these fish (number dependent upon availability, but at least 50% or 500) will be released in San Juan River at Animas and San Juan rivers confluence. Prior to release, these fish will be

acclimated to ambient water temperature for at least 24 hours. Dispersal, growth, and habitat use of these fish will be determined by subsequent capture during other ongoing San Juan River research and management activities. To extent feasible, habitat parameters at each capture site will be characterized. Minimally, location (nearest RM), length, and mass of each captured fish will determined and recorded. Depending upon spawning success and survival, considerably more roundtail chub (100 to 200 mm TL) may be available for stocking. If so, these fish will also be stocked in San Juan River.

Fish not released will be maintained at Mumma SFH. A portion of these may be retained for future brood stock. Those not retained for brood stock will be kept until of sufficient size to allow radio transmitter implantation (ca. 350 mm TL). At least 10 specimens will be implanted with radio transmitters; 5 will be released near Animas and San Juan rivers confluence and 5 near Four Corners. Fish will be located weekly for first 4 weeks following release and thence monthly until next spawning season. During presumed spawning season (May and June), weekly tracking will be reinitiated. If spawning activity is suspected, efforts will be made to track individual(s) for 24 hours. Location and general habitat parameters (habitat type, water velocity, water depth, and water temperature) will be measured and recorded for each radio contact.

Survival of wild fish in hatchery will determine, in part, need for additional wild fish. Minimally, 20 mature pairs from each source population will be maintained. These 20 pairs may be solely wild fish or mix of wild and hatchery produced. At least once every 2 years a minimum of 20 wild fish from each source will be captured to augment brood stock.

The second phase of the proposed study will be to develop an augmentation plan for roundtail chub in the San Juan River basin. Aside from hatchery considerations and options, the augmentation plan will estimate the carrying capacity of the San Juan River for roundtail chub. The likely demographics of roundtail chub in San Juan River basin prior to human modification (ca. 1850) are impossible to determine. However, information on other rivers within its historic range that continue to sustain demographically and genetically viable populations of roundtail chub will provide insights to what the San Juan might be capable of supporting. Published and unpublished data from these populations will be used to develop population goals for roundtail chub in the San Juan River basin.

Data obtained from hatchery propagation efforts, captured PIT tagged fish, and tracking of radio-tagged fish in the San Juan River also will be used in augmentation plan development.

Although considerable effort has been expended to determine the genetic affinities and differences of Colorado River basin *Gila* spp, no work has been accomplished on genetic relationships among roundtail chub populations or sub-populations in the San Juan River basin. Genetic data (minimally allozymic) is necessary to develop appropriate breeding protocols (for example, is it appropriate to maintain separate brood stocks for each source population?) and to determine where each source population should be stocked (or not) in mainstem San Juan River. Unless (and until) sufficient genetic information is obtained to indicate otherwise, source populations will not be crossed in hatchery propagation efforts. Genetic analyses will be conducted on tissue samples from fish from each source that are taken to hatchery. Results are expected to help simplify rearing logistics and costs as well as aiding in development of breeding and stocking protocols.

Based upon information from above sources, the potential for restoration of a demographically and genetically viable population of roundtail chub will be determined. If restoration of the species is feasible, an augmentation plan specific to the San Juan River will be developed. The augmentation plan will identify

factors that currently limit restoration potential and actions that may diminish or eliminate limiting factors. In addition to identifying hatchery production protocols (based on genetic considerations) and numbers of fish, the plan will identify where chubs should be stocked to maximize survival potential. Based upon published and unpublished literature and data obtained from released fish, population goals will be developed for roundtail chub in San Juan River. A tentative schedule to achieve population goals will be developed.

The draft augmentation plan will be submitted to SJRIP Biology Committee for review and approval. Following Biology Committee review and approval, the plan will be submitted to SJRIP Coordination Committee review and approval.

Schedule (federal FY)

2000-2001: Capture and hatchery maintenance and spawning of wild fish. Possible stocking of PIT-tagged fish in autumn 2001. Obtain and review pertinent literature for augmentation plan. Conduct genetic study of captive stocks to determine relatedness of source populations.

2001-2002: Rear hatchery spawned fish, spawn brood stock, and, if necessary, obtain additional wild fish. Obtain and review data on captured PIT-tagged fish. Stock PIT-tagged fish. Incorporate new data and continue drafting augmentation plan. Conduct genetic study of extant wild populations of roundtail chub in San Juan River basin.

2002-2003: Continue hatchery production and stocking of PIT-tagged fish. Continue data collection on stocked fish (tagged and untagged). By autumn 2002, release radio-tagged fish. Track per protocol. Complete genetics study and augmentation plan.

2003-2004: Implement augmentation plan and monitor stocked fish (tagged and untagged). Continue hatchery propagation per augmentation plan.

2004-2007: Continue hatchery production, augmentation, and monitoring.

2007-2008: Assess augmentation program.

Budget:

2000-2001:	$20,000 ($12k—capture, $8k—propagation)
2001-2002:	$40,000 ($20k—capture and propagation, $20k—genetic study, $0k—augmentation plan)
2002-2003:	$50,000 ($20k—capture and propagation, $20k—tracking, $10k—genetic study, $0k—augmentation plan)
2003-2004:	$40,000 ($20k—capture and propagation, $20k—tracking and monitoring)
2004-2007:	$40,000/yr ($20k/yr—capture and propagation, $20k/yr—tracking and monitoring).
2007-2008:	$10,000 (augmentation and assessment)

Literature Cited:

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V. Hydrology Committee Proposals

San Juan RIP Naturalized Flows
Recommendations For Addressing Problems

Background:

Development of a San Juan River Basin hydrology model to be used in developing flow recommendations and analyzing impacts of water development on the ability of the system to meet the flow recommendations was begun in 1996. The Animas-La Plata Project (ALP) Section 7 Consultation under the Endangered Species Act (ESA) set a 7-year time frame to complete flow recommendations for the endangered fish. This consultation and the Navajo Indian Irrigation Project consultation limited water development in the basin to the baseline depletion established for ALP until flow recommendations were established. To meet the schedule set forth in the ALP Consultation, it was necessary to complete the model by December 1997 to allow development of the flow recommendations in 1998. Reclamation developed naturalized flow estimates for 1970-93 at 23 gages in the San Juan Basin (special study) and at two gages from 1906-1985 (Colorado River Storage System (CRSS)). These flows were developed using consistent techniques, to the extent that they were known, although not entirely consistent input data. It was thought at the time that these flows would be the most appropriate to use because of the long history of their use. Therefore, Reclamation naturalized flow estimates for the period 1929 -1993 were utilized.

Several problems were identified with the naturalized flows during the decision model development process. Prior to 1970, the naturalized flow estimates were only available for the San Juan River at Archuleta, NM and near Bluff, UT, for which a spatial dis-aggregation was employed to provide flow at the other required points. The pre-1970 process was not well documented and some problems existed in completing the McElmo Basin, complicated by imports from the Dolores River. In addition, the method used for estimating shortages in water-short drainages has limitations and the handling of return flows followed methods developed prior to the use of computer models, whereby return flow lagging was not considered. Even though these were identified as problems, it was felt that the accuracy would be sufficient for the immediate purpose of developing flow recommendations and assessing impacts.

In the process of model development and implementation several other problems have been discovered and the implications of the previously identified limitations better understood. The following problems have been identified:

A. Type I shortage[4] computations are difficult to replicate and may not accurately reflect true shortages. Some areas which should have been shorted were not, especially in the New Mexico portion of the La Plata Drainage.

B. Data inconsistent with the consumptive use and losses (CU&L) studies in the 1970-93 period were used, particularly New Mexico non irrigation data.

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4 Type 1 shortage computations are based on a procedure documented in the "Upper Colorado Region, Comprehensive Framework Study," Upper Colorado Region State-Federal Interagency Group, 1971. This study outlined a procedure for calculating water shortages for crops with a limited water supply.

C. Net reservoir evaporation procedures use a constant rate from year to year for each month, resulting in estimating errors.

D. Return flows are not lagged, resulting in flow timing errors.

E. Large unexplainable losses in some reaches resulting from gage error may underestimate flows in some critical months, usually during spring runoff. It is also likely that some flows are overestimated for the same reason.

F. The lack of documentation of off-stream depletions makes their inclusion difficult to represent, with either under or over estimation of available flows depending on assumptions used, with no way of resolving the uncertainty.

G. Depletion sources are unknown in some of the CRSS data set prior to 1970.

H. Numerous adjustments in the naturalized flows are presently employed in the San Juan RiverWare model to correct for known deficiencies, making documentation and tracking difficult.

I. The need to handle future projects appropriately results in configuration inconsistencies between the naturalized flow estimation process and the San Juan model in some cases, for which corrections and approximations are necessary for calibration. For example, if the configuration of the Pine River Basin is changed, the method of forcing shortages by requiring bypass flows is no longer valid and a correction must be employed.

Planned future development has now reached the level that a more accurate representation of naturalized flows and the assumptions behind them are necessary in order to accurately assess the relationship between increasing levels of development and the ability to meet flow recommendations for endangered fish. Furthermore, a more accurate assessment tool is needed as the flow recommendations are reviewed through the adaptive management process. This proposal outlines an approach to correct the deficiencies in the naturalized flow process and to incorporate into the San Juan model more appropriate approaches to issues such as shortage assessment, lagged return flows and reservoir evaporation, made possible by improvements in the naturalized flow estimation process.

References are made in this document to the relationship between water development and meeting flow recommendations for endangered fish. It is recognized that the U.S. Fish and Wildlife Service ultimately determines the requirements for the endangered fish as they consider impacts of future development through the Endangered Species Act consultation process. Meeting flow recommendations put forth by the San Juan River Basin Recovery Implementation Program is just one of the measures of sufficient progress toward recovery that they consider. Nothing discussed here shall be construed as pre-determining any requirement for approval of additional water development, including meeting flow recommendations. The processes discussed here simply analyze the impact of development on the ability to meet the flow recommendations, not the ultimate ability for future development to move forward.

Objectives:

Review of the modeling process over the past four years by the ad-hoc hydrology group has indicated discomfort by some members in the modeling process, approach and results. Many of the concerns deal with modeling approach taken to replicate the calculations made in estimated natural flows and documentation of processes. Addressing naturalized flows must, therefore, address the concerns of the group.

Furthermore, identification of more flexibility in the water supply is desirable, including the ability to meet the various water demands on the system. While development of improved estimates of natural flows is no guarantee of an increased water supply, it will certainly increase the confidence in the estimates made.

To address these concerns and provide for better buy-in by the stake holders, the following objectives are proposed:

1. Improve confidence in model results through improved data consistency, quality, exchange, maintenance, and management.

2. Provide review and input from stakeholders during the development process.

3. Incorporate existing data (Colorado Decision Support System (CDSS), State, Tribal and Federal Agency data) to the maximum extent possible.

4. Provide a cleaner process with more straightforward documentation that is understandable to a broader audience.

Approach Options

Several approach options were explored and rejected, including use of existing CDSS naturalized flows without modification and independent recomputation of naturalized flows without utilization of CDSS analysis completed to date. After careful review, it was decided that utilizing CDSS as the natural flow generator with improvement of the non-Colorado data was the most cost effective approach. Recomputing naturalized flows independent of the CDSS process does not appear to be cost effective and would require considerably longer time. Utilizing CDSS without modification would not correct all the errors.

Recommended Approach

To most efficiently use existing data, it is proposed that the naturalized flows be generated with the CDSS model and that the generated naturalized flows be incorporated into the RiverWare based San Juan model. This will require an update of the non-Colorado data in CDSS, development of a data interface between the two models and reconfiguration of the San Juan model to match the CDSS nodes and functionality.

The following tasks outline activities anticipated for completion of the naturalized flow redevelopment and model reconfiguration. The tasks are designed to rectify existing identified problems and address

concerns of committee members with the existing model while improving accuracy of and confidence in model results. The tasks are divided into those that could be accomplished without completing a full analysis and re-computation of naturalized flows and those that require naturalized flow re-development and model reconfiguration.

I. Analyze gage errors and correct gage record as required for reasonable water balance.

Relationship to naturalized flow study: Could be implemented in existing model as a naturalized flow correction. Required as a part of the naturalized flow study.

Need: Existing gage records show periods of channel losses between gages, particularly between Bluff and upstream gages, that exceed reasonable losses. The losses usually occur during snowmelt runoff when flows are high and are as much as 100,000 AF in a given month when adjusted for other gaged inflow and diversions between gages. These large losses result in an under-estimation of streamflow and a model-projected failure to meet flow recommendations during times that they would otherwise be met.

Impact on available water: These errors have a direct impact on available water. While the magnitude of the errors have not been precisely determined nor the impact of their correction modeled, it is anticipated that additional water to meet the various system demands or more flexibility in dam operation may be provided.

Approach: A down-river water balance will be computed utilizing Archuleta, Animas at Farmington, San Juan at Farmington, Shiprock, Four Corners and Bluff gages. To identify the errors, unexplained gains and losses would be computed for each reach by adding gaged inflow and subtracting phreatophyte losses and estimated depletions between gages. An assessment of change in groundwater storage will also be computed and included in the analysis. Corrections to the computed gain or loss will be applied to adjust flow at anomalous gages by comparing gain/loss in adjacent reaches and adjusting the gage in error to arrive at balanced gain/losses relative to reach conditions. Previously estimated phreatophyte losses and man-induced depletions will be utilized in completing the adjustments. A technical memorandum will be prepared (funded under the documentation task, but completed within the schedule for this task) and circulated for review and approval of the approach by the Hydrology Committee and USGS prior to implementation.

Responsible Party: Consultant

II. Evaluate CDSS model and databases, methods and documentation, resolve differences with San Juan River Basin Models (SJRBM) and data, and develop interface approach.

Relationship to naturalized flow study: Required as a part of the naturalized flow study. Not needed otherwise.

Need: CDSS and RiverWare presently do not have the same file structure, data needs or functionality. A careful review of the CDSS models, databases, and subsequent naturalized flow generation process is needed to develop the approach to interface the two modeling systems.

Approach: Reclamation will work with the state of Colorado or a designated consultant familiar with CDSS to resolve differences including depletion categories, modeling of offstream depletions, generation of synthesized data, nomenclature and configuration, and flow computation procedures and assumptions. Any functionality that would need adjustment in CDSS as recommended by the Hydrology Committee would also be identified. Once all issues are identified, a process for interfacing the two models would be developed, including methods of implementing CDSS functionality in RiverWare.

Responsible Parties: Reclamation and either the state of Colorado, a consultant familiar with CDSS or a combination.

III. Develop data storage, analysis and retrieval system, including Data Management Interfaces (DMI's) between respective applications and databases.

Relationship to naturalized flow study: Required as a part of the naturalized flow study. Not needed otherwise.

Need: To provide seamless data sharing and analysis and to enhance model documentation, maintenance and upgrade functionality. interface tools (DMI's) will be developed.

Approach: This task addresses data handling only, whereas Task B is specific to modeling processes and interface approach. To the extent possible, data will be shared between databases using standard database exchange protocol, not directly between models. Text file formats will be consistent with existing data formats or as designed by the team. All CDSS computed data including depletions, synthesized flows, and naturalized flows will be populated in an appropriate Reclamation database. The population process will be automated to the extent possible, to improve the process of updating data. Data Management interfaces (DMI's) will be developed for each model to allow extraction and importation of the appropriate data from the respective databases. Reclamation has existing GIS and time-series databases that run on various platforms. DMI's that communicate between databases and applications use Open Database Connectivity (ODBC) and Java Database Connectivity (JDBC) which are standard protocol for database communications. Existing databases or schemes would be enhanced and extended to support SJRBM. Data entry, data retrieval, and data integrity will be facilitated by use of databases and standard communication protocols.

Responsible Parties: Primarily Reclamation with some consultant time. Consultant must be familiar with CDSS and/or RiverWare.

IV. Correct 1970-1993 database to address concerns.

Relationship to naturalized flow study: Required as a part of the naturalized flow study. If naturalized flows are not recomputed according to the process outlined, then this task should go forward to correct known problems. The scope would change, however.

Need: The non-Colorado data in the CDSS database consists of the same values used in the present RiverWare model. There are some uncertainties concerning representation of values in the

model, including reservoir evaporation, inconsistencies in non-agricultural depletions, concerns over crop mix and acreage and differences in estimates of consumptive use. These data elements need to be reviewed, updated and corrected to improve accuracy of naturalized flow estimates during this period.

Approach: Reclamation will work with the state of New Mexico to resolve differences in assumptions concerning New Mexico depletion issues, with review and approval by the Hydrology Committee before inclusion in the model. Reservoir net evaporation rates (evaporation less rainfall) for all reservoirs in the basin will be computed on a monthly basis for the period of record, rather than using average values as presently done. Arizona and Utah depletions will be reviewed, corrected and updated prior to inclusion in the database. All new data will be provided to Colorado for inclusion in the naturalized flow computation. The data will be provided as text files for inclusion through CDSS DMI's. All new information will be reviewed by the Hydrology Committee before final inclusion into the model.

Responsible Parties: Primarily Reclamation, with support from consultant familiar with the San Juan Basin, working with the states of New Mexico, Utah and Arizona.

V. Extend data sets that do not exist to 1929.

Relationship to naturalized flow study: Required as a part of the naturalized flow study. Even if naturalized flows are not re-computed, analysis and verification of the nature of depletions prior to 1970 should be completed, although the analysis would be different.

Need: The approach to naturalized flow development in CDSS for Colorado is well documented for the entire modeling period from 1929 through 1998. Only review of the data with a possibility of minor corrections will be required. The sources and nature of the 1929 - 1970 data in the other states are not well documented. Presently, RiverWare assumes that off-stream depletions were computed in the same manor as the 1970-1993 period. Recent reports published by Reclamation (Colorado River Surplus Criteria, DEIS, July 2000) indicate that these off-stream depletions were not separately computed, but were lumped into the naturalized gain/loss for the reach in which they occurred. If this is truly the case, then available water is underestimated with the model.

Approach: The Colorado information will be reviewed and assessed for any needed changes, particularly in filling missing data. Any needed improvements will be implemented after Hydrology Committee approval. It is anticipated that the changes will be small, if any. Existing documentation for New Mexico, Arizona and Utah depletion estimates will be reviewed and the data validated and corrected, if necessary, utilizing consistent techniques for the full 1929-1993 period.

Responsible Parties: Primarily Reclamation with some assistance from a consultant.

VI. Extend data sets forward through WY1999

Relationship to naturalized flow study: Optional analysis not necessary to match existing data set, but helpful for overall model maintenance, meeting the goals to periodically update the analysis period.

Need: Extension of the full data set maintains consistency with CDSS approach to maintain naturalized flows and modeling capability to within two years of current data and meets the goal of keeping the San Juan model current.

Approach: Depletion and water supply data will be updated based on existing data for the 1994-1999 period. Data will be entered into the CDSS database or interfaced through DMI's and utilized in the San Juan model, maintaining consistency of approach with the earlier period of record.

Responsible Parties: Primarily Reclamation with some assistance from a consultant.

VII. Configure CDSS for full data set and compute naturalized flows for the period of available data.

Relationship to naturalized flow study: Required as a part of the naturalized flow study. Not needed otherwise.

Need: The most cost-effective method of naturalized flow computation is to use the existing CDSS model.

Approach: Colorado or a consultant familiar with CDSS will update the CDSS database with data produced under the foregoing tasks, configure CDSS for naturalized flow calculation and operate the model to produce the monthly naturalized flows at the nodes identified in the model structure. Naturalized flows will be verified by operating the model in simulation mode with the configured depletions, comparing predicted flows against gage.

Responsible Parties: Primarily a consultant familiar with CDSS or the state of Colorado, with input from Reclamation.

VIII. Develop CDSS functionality in RiverWare.

Relationship to naturalized flow study: Required as a part of the naturalized flow study and model redevelopment. Not needed otherwise.

Need: To utilize CDSS generated naturalized flows, the San Juan model must replicate the methods used in CDSS.

Approach: CDSS functionality and nodal configuration will be analyzed and replicated in RiverWare. Some additional coding may be required to allow efficient replication. Return flow lagging and delivery priority are two known areas of additional functionality that must be

implemented in RiverWare. Methods for handling variable irrigated area and variable efficiency depending on water supply presently included in RiverWare, may need implementation in CDSS. Upon review and approval of the Hydrology Committee, the identified functionality will be included in the appropriate model.

Responsible Parties: Primarily Reclamation with some consultant input.

IX. Disaggregate monthly naturalized flows, diversions and depletions into pseudo daily values.

Relationship to naturalized flow study: Required as a part of the naturalized flow study and model redevelopment. Not needed otherwise.

Need: The flow recommendations require an estimate of timing of flows on a daily basis. The present San Juan model operates on a monthly time-step with results disaggregated into pseudo-daily values below Navajo Dam in a post processor, requiring recomputation of water balance for each run. As water development increases and the depletions depart from the historic pattern, this method becomes less accurate. Disaggregation of the naturalized flows and system demands below Navajo Dam into a pseudo-daily time step provides the most consistent method of approximating naturally shaped hydrographs necessary for the flow recommendations.

Approach: Once monthly naturalized flows are computed and calibrated, they would be disaggregated into pseudo-daily values by utilizing the gage pattern of a key-station representing reasonably naturalized flow for the same or similar drainage, adjusting values to maintain water balance and eliminate negative flows. A process would be developed and implemented for disaggregating monthly diversions and ET into pseudo-daily values. Non-irrigation demands would be computed on a psuedo- daily basis as well.

Two model implementations are possible. The first would be to continue the monthly operation, but prepare model rules that would maintain pseudo-daily accounting with the disaggregated values for each model object downstream of Navajo Dam. Upstream of Navajo Dam, the monthly time step would remain. San Juan-Chama diversions would be computed on the same pseudo-daily basis presently used in the model. The second approach would be to develop a psuedo-daily time-step model. To improve execution speed, a two-step process could be used whereby a full detail run would be completed and the tributaries not affected by operation of Navajo dam output. Then all the simulation runs could be completed utilizing the output from the detailed model for these "fixed" elements. In either case, additional calibration would be required to demonstrate agreement with gage flow. The final approach decision would be based upon an investigation of the practicality of each approach and the approval of the hydrology committee.

Having available the daily values in the model allows the Navajo Dam operating rules to have access to the data upon which the flow recommendations are based. It is likely that

the operating rules will change based upon this new available data, requiring development of new rules within the San Juan model.

Responsible Parties: Reclamation and consultants.

X. Update and calibrate the San Juan Basin RiverWare simulation model to match CDSS configuration.

Relationship to naturalized flow study: Required as a part of the naturalized flow study and model redevelopment. Not needed otherwise.

Need: Configuration to match CDSS functionality, nodal structure and results are necessary for correct utilization of CDSS naturalized flows. The present model has a number of processes that have been implemented to match USBR naturalized flows that have been the source of concern for model reviewers. Re-configuration to match naturalized flow assumptions is necessary to alleviate these concerns.

Approach: Once the functionality described in task H is completed, the RiverWare model will be configured to match CDSS on a monthly time step and calibrated to monthly gage flows. When satisfied with the results of the monthly calibration, the psuedo daily values will be introduced and again calibrated against gage flows. This second calibration step will attempt to match hydrograph shape by month, rather than target specific daily flows. In completing this calibration step, monthly mass balance will be preserved. The hydrograph shape calibration will utilize only the daily disaggregation features to avoid disrupting the monthly calibration. The final steps are to implement the reservoir operating rules designed to meet the flow recommendations, configure the model with the present baseline depletions and complete model simulations to optimize meeting system demands, including those for irrigation, municipal, industrial and fish and wildlife.

Responsible Parties: Reclamation and the consultants who assisted with the daily disaggregation.

XI. Coordinate development with Hydrology Committee and Interested Parties.

Relationship to naturalized flow study: Required as a part of the naturalized flow study and model redevelopment. Not needed otherwise.

Need: The quality of the model is improved as it is reviewed by an oversight group. The Hydrology Committee has been developed for that purpose. Other interested parties not presently participating on the Committee may also want review opportunity.

Approach: Reclamation and the involved consultants will prepare interim review documents and presentations to brief the interested parties on progress at key points in the development process as indicated in the tasks above and to incorporate input from the Committee. These will be presented at regularly scheduled committee meetings.

Responsible Parties: Reclamation and consultants in relation to work completed by each.

Develop documentation.

Relationship to naturalized flow study: Required as a part of the naturalized flow study and model redevelopment. Documentation is required for any task completed.

Need: One of the key limitations in the development of the San Juan model to date has been the lack of, or difficulty in following, documentation of work performed in the past. Presently, documentation is being revised to better describe the process to date. Appropriate review and efficient long-term maintenance requires good documentation

Approach: During the completion of each task, detailed notes will be maintained and documentation of the completed task prepared. This documentation will be combined into formal model documentation, covering the basis of the naturalized flows, the construction of the model and a guide to model operation. Also, included will be a process for maintaining version control and archiving previous versions of the model and associated data relating to any key utilization of the model.

Responsible Parties: Reclamation and consultants in relation to the work accomplished.

Schedule and Cost:

Research funds are being used to improve RiverWare's ability to predict diversion response to water supply, to add recognition of lagging to downstream demand computations to RiverWare, to design a data centered system, and to implement a prototype of a data centered system. CRSS personnel will assist in location of pre 1970 CRSS data. Funding sources have to be determined for remaining work listed in Table 1.

Some work may be most appropriately handled by consultants or other agencies with specific experience with certain data sets. For example, the state of Colorado or a designated consultant familiar with CDSS may be appropriate for inclusion and use of the CDSS database, and operation of CDSS in the naturalized flow estimation process. An independent consultant could be retained to analyze and correct gage records. Daily disaggregation may be most efficiently handled by the consultant that has developed the approach presently used and is familiar with the data. Therefore, a team approach is envisioned with the involvement of several individuals to accomplish the work. The approach has proven to be effective in the past and is recommended here.

Table 1 tabulates the estimated man power, cost and schedule expected to complete items A through L in the study. The data extension task is optional.

The schedule shown in Table 1 assumes funding in FY2001, with work beginning October 1. Completion is expected to take one year.

Reclamation and the involved consultants will prepare interim review documents and presentations to brief the interested parties on progress at key points in the development process as indicated in the tasks above. This information will be presented at regularly scheduled committee meetings.

Table 1. **Estimated schedule, labor requirement and cost for completion of naturalized flow analysis and model development**

	Task	Expected Schedule	-Professional time - Man-days - Reclamation	Consultant	Total	- - - - Estimated Cost - - - - Labor	Expenses	Total
A.	Analyze and correct gage errors.	Nov-00		15	15	10,500		10,500
B.	CDSS interface	Nov-00	5	30	35	24,500	1,000	25,500
C.	Data system development	Jan-00	55	20	75	52,500	1,000	53,500
D.	Correct 1970-1993 database	Mar-01	20	20	40	28,000	1,000	29,000
E.	Extend data sets to 1929	Apr-01	55	20	75	52,500	1,000	53,500
F.	Extend data sets from 1993 - 1999	May-01	20	10	30	21,000	500	21,500
G.	Configure and Calibrate CDSS	Jun-01	10	30	40	28,000	2,500	30,500
H.	Implement functionality in RiverWare	Jun-01	20	5	25	17,500	2,500	20,000
I.	Daily disaggregation	Aug-01	5	35	40	28,000	1,000	29,000
J.	San Juan Model upgrade/calibration	Sep-01	50	40	90	63,000	4,000	67,000
K.	Coordination with stakeholders	Throughout	10	10	20	14,000	3,000	17,000
L.	Develop complete documentation.	Nov-01	30	30	60	42,000	1,000	43,000
	Total		305	240	545	381,500	18,500	**400,000**

Improve Stream Gaging and Improve Flow Measurements in the San Juan River System

Background:
There are five USGS streamflow gaging stations on the main stem of the San Juan river that are very important to the operation of the river and play an important role in the implementation of the flow recommendation for the recovery of the endangered fish.

Need:

Problems have been encountered using the data from these stations during the past year. There have been problems with operation of the stations as well as inaccurate information being received from the stations. One big factor is the variability of the river and its ever-changing channel due to sediment load.

Approach:

1. The Hydrology Committee is recommending that additional resources be applied in order to get better flow measurements and suggest that measurements be taken and the stations serviced, at least twice as often, on the four stations on the San Juan River in New Mexico. Visiting the stations one additional time per month would cost $1,809 per month ($21,708 per year). The stations are now visited on a monthly basis. The table shown below gives a cost estimate from the USGS showing its cost of servicing all the stations.
   (Note: Contacted USGS in Utah concerning the gage at Bluff, Utah. They questioned if servicing the station more often would improve the accuracy. More information on the gage at Bluff, Utah will be supplied at the Coordination Committee Meeting.)

2. The USGS is also recommending moving the gage at San Juan River near Four Corners across the stream. It appears that recent changes in the stream channel have isolated the gage. Temporary remedies have been made but the gage needs to be moved to give better data. They estimate it would cost approximately $3,000 to relocate this gage.

3. The USGS is also going to move the gage at San Juan River at Shiprock up stream to a new site where it is not vandalized and has a better control. They are going to do this as soon as they receive the necessary permission from the land owners. They will need no additional funding for this.

   However, the cableway for the gage at San Juan River at Shiprock is several miles downstream from the existing gage and will be even further once the gage is relocated. They are recommending that the cableway be moved closer to the gage site. They are estimating that it would cost approximately $25,000 to relocate the cableway.

The USGS is preparing a more detailed cost estimate that will be available for the September 19, 2000, Coordination Committee meeting. The Hydrology Committee recommends that the Recovery Program

make the necessary arrangements to have the USGS proceed with items 1 and 2 and that additional studies be conducted for item 3 before recommendations are made.

Budget:

Proposed costs for additional field run for the San Juan River

	unit	number units	unit cost	total (Rounded)
Labor (1 Hydrologic Technician)	hour	24	$ 24.55	$ 589
Per Diem	day	3	$ 80.00	240
Vehicle	mile	700	$ 0.215	151
Project net				980
Reports surcharge				27
Net Total				1,007
Overhead				802
GROSS TOTAL per month				**$ 1,809**
TOTAL PER YEAR				**$ 21,708**

Additional Model Runs

Background:

In addition to the model improvements, the Hydrology Committee plans to conduct model "runs" to evaluate hydrology issues and sensitivity.

Need:

These "runs" would be at the request of the Coordination, Biology, or Hydrology Committees.

Approach:

The runs would be conducted using the most current version of the model. In order to fund these model "runs" the Hydrology Committee is requesting $10,000 for Bureau of Reclamation to perform the work.

Budget:

Personnel	$10,000

VI. Program Coordination and Program Management Proposals

Program Coordination
Fiscal Year 2001 Project Proposal

U.S. Fish and Wildlife Service
P.O. Box 1306
Albuquerque, New Mexico 87103-1306
(505) 248-6806
Shirley_Mondy@fws.gov

Background:

The San Juan River Recovery Implementation Program (SJRRIP) is designed to simultaneously address endangered fish species recovery and development of water resources within the Basin. The SJRRIP includes representatives from not only Federal agencies, but also the States of Colorado and New Mexico, the Jicarilla Apache Tribe, the Southern Ute Tribe, the Ute Mountain Ute Tribe, the Navajo Nation and the water development interests, most of which have legal mandated responsibilities to the endangered fish and/or the water resources.

Focus for Fiscal Year 2001 Program Coordination activities will be the continued printing and dissemination of final reports from the original seven-year research program and the printing and dissemination of the revised Long Range Plan.

In addition, the role and responsibilities of the Program Coordinator have expanded to encompass more public outreach. As a result, we will finalize the Public Outreach Plan which will include an increased distribution of Program information, enhancement of the current website and development of a Program brochure and traveling display.

The Program Coordinator was tasked with developing general program guidance and scheduling for the Annual Work Plan. This will involve working with all Committees and the different funding agencies to ensure budgetary requests are developed in appropriate time frames. If the pending funding legislation is approved, a tracking system will have be necessary to monitor expenditures and progress in the Program.

Objectives:

1. Attend and assist with coordination of the Biology, Hydrology and Coordination Committee meetings.

2. Disseminate relevant information to the Coordination, Biology and Hydrology Committee members and to other partners, especially State, Federal, and Tribal agencies.

3. Develop program guidance and schedule for the Annual Work Plan. If the legislation is approved, develop process to track and monitor progress and expenditures.

4. Finalize the Public Outreach Plan.

5. Participate in meetings hosted by the Bureau of Reclamation regarding the reoperation of Navajo Dam.

6. Enhance the public information web site and develop a brochure containing information on and accomplishments of the San Juan River Recovery Implementation Program.

Products:

1. Final Public Outreach Plan

2. Enhanced SJRIP Web Site

3. Brochure and traveling display on SJRIP

4. Printing of the remaining 7 yr Reports and Long Range Plan

Budget:

Personnel		
Coordinator (½ time salary and benefits)		
Executive Assistant (½ time salary and benefits)	$	71,500
Travel/Per Diem		
Coordinator and Executive Assistant	$	10,500
Committee Meetings		
supplies, meeting space, mailings, public notices	$	7,000
Printing/publication/mailings	$	8,000
Traveling display and brochures	$	12,000
TOTAL	**$**	**109,000**

Program Management
Base Funding
2001 Work Plan
U.S. Bureau of Reclamation

Background:

Program Management funds support Reclamation program administration of base funded activities. Funds reserved for Program Management are used to provide staff time for general program management and participation in Program activities undertaken by the Biology and Hydrology committees, including committee assignments not specifically identified in a scope of work, and administration of funding agreements. During 2000, activities conducted by Reclamation included implementing requisitions for program supplies, participation in the Recovery Program Committees committee assignments, coordination of water operations and program activities, and administration of funding agreements with cooperating agencies. Future levels of program management funding can be expected to vary as base funded research and monitoring funding increase or decrease.

Management support for Capital fund projects, including technical oversight, budgeting, preparation of bids and funding agreements is covered withing specific budgets for capital fund projects and are not included as part of this program management scope of work

Tasks - 2001

1. Administer and modify as needed, existing Intra-agency agreements with: U.S. Fish and Wildlife Service Region 6, U.S. Fish and Wildlife Service Region 2, for research and monitoring activities

2. Administer and modify as needed, existing Cooperative Agreements with: the states of New Mexico, Utah, Colorado, and the University of New Mexico at Albuquerque for research and monitoring activities.

3. Distribute Bureau of Indian Affairs contributions to research program through existing agreements.

4. Implement additional Cooperative Agreements or interagency acquisitions and requisitions as needed for base funded activities.

5. Support base funded research and monitoring activities and implement various assignments not identified within specific scopes of work as determined by Program Committees.

Budget

Personnel	$50,000
Travel/Per Diem	15,000
TOTAL	**$65,000**

Capital Improvement Management
San Juan River Recovery Program
FY-2001 Proposed Scope of Work

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Purpose:

The purpose of the San Juan Capital Improvements Program is to implement those improvements which have been identified by the Program as necessary for the recovery of the endangered fish. Implementation includes construction and preconstruction activities such as alternative studies, design, NEPA compliance, operation and maintenance agreements and permitting. Capital improvements usually result in an observable product that directly effects the endangered fish. A gage installed as part of a fish passage would be considered a Capital Improvement whereas a gage to measure river flows for river operation or modeling would not. Stocking of fish is usually considered a Capital Improvements activity. Studies or analysis of river flows, population response, habitat preference are usually not considered Capital Improvements.

FY2001 Capital Project Activities:

1. PNM - Plan, design and award a contract to construct a fish passage at the PNM Diversion Dam.

2. Hogback and Cudei - Reimburse NIIP for costs of constructing fish passage on Hogback and Cudei Diversion Dams.

3. Capital Projects Program Management - Capital Project Coordination funds are used to manage, monitor and implement the San Juan Recovery Program Capital Projects. Funds will be utilized by participating Reclamation Offices (Upper Colorado Regional Office, and Western Colorado Area Office) staff engaged in Capital Project features.

Study Schedule and Budget:

Task	1999	2000	2001	2002	2003	Total
Task 1		$ 122,000	$ 1,558,500			$ 1,680,500
Task 2		$ 400,000	$ 871,500	$ 638,500		$ 2,000,000
Task 3	$ 124,000	$ 75,000	$ 80,000	$ 80,000	$ 80,000	$ 439,000
Total	$ 124,000	$ 597,000	$ 2,510,000	$ 718,500	$ 80,000	$ 4,119,500
Federal Appropriations		$ 597,000	$ 1,437,000	$ 1,694,000	$ 1,484,000	$5,212,000
Non-Federal funding			$ 1,193,000	$ 1,406,000	$ 1,667,000	$4,266,000
Total funds available			$ 2,630,000	$ 3,100,000	$ 3,151,000	$9,478,000

Future Capital Projects:

After the completion of fish passage projects at PNM, Hogback and Cudei Diversion Dams, no other Capital Projects have been identified. The Program needs to identify needs for other capital projects such as fish augmentation, additional fish passage requirements, and non-native fish control.

2001 Deliverables:

1. Award PNM contract.

2. Hogback Diversion Dam and Fish passageway construction. Repay BIA for Hogback construction.